

TAXONOMIC STUDY OF MACHAERANTHERA, SECTIONS MACHAERANTHERA
AND HESPERASTRUM (ASTERACEAE)

B. L. Turner

Department of Botany, University of Texas, Austin, TX 78713

ABSTRACT

The sections Machaeranthera and Hesperastrum of the genus Machaeranthera are treated systematically. The former is comprised of two species, M. tanacetifolia and M. tagetina. The section Hesperastrum is comprised of three species: Machaeranthera asteroides, with three varieties; M. bigelovii, with three varieties; and M. canescens, with ten varieties divided among two subspecies. Keys to these various taxa are provided along with distribution maps. In addition, a chromosomal review of the sections is provided which includes numerous previously unreported chromosome counts. All counts were diploid with $2n=8$. One new combination, M. canescens subsp. glabra, is proposed.

The genus Machaeranthera was established by Nees in 1832. The generotype, M. tanacetifolia, is a widespread, erect, tap-rooted, annual with lavender rays and a base chromosome number of $x=4$.

Most subsequent workers, A. Gray for example, reduced Machaeranthera to sectional status and placed it within the broad fabric of Aster. As such, the section included several seemingly disparate elements, for example the lavender-rayed Machaeranthera gymnocephala, which Greene (1894) placed in his newly resurrected Eriocarpum. Hall (1928) transferred all of the latter into his broadly conceived Haplopappus, placing these into his section Blepharodon. Shinnars (1950) reunited Blepharodon (including Eriocarpum) with Machaeranthera, which he accepted as a genus distinct from Aster. Cronquist and Keck (1957), while recognizing Machaeranthera as a genus, nevertheless retained section Blepharodon in Haplopappus (sensu Hall), despite the removal of its type species, Machaeranthera gymnocephala, which, along with several other lavender-rayed taxa, was placed in the series Originales of Machaeranthera.

Hartman (1976) has reviewed in much greater detail the information presented above. Indeed, after poring over his unpublished thesis for a number of years now, I find his treatment remarkably thorough and taxonomically sound. Consequently I have little hesitation in taking up the arrangement and nomenclature which he provided.

Hartman treated Machaeranthera as comprising eight sections. These were divided into two subgenera, as follows:

Subgenus Machaeranthera

1. Machaeranthera
2. Blepharodon
3. Hesperastrum
4. Arida
5. Psilactis

Subgenus Sideranthus

6. Sideranthus
7. Havardii
8. Stenoloba

Hartman's thesis largely dealt with the section Blepharodon and little detailed attention was given to the taxonomically difficult sections Machaeranthera and Hesperastrum. The latter, in particular, comprise the largest, most variable elements within Machaeranthera, these being the most commonly encountered taxa in the western United States.

The sections Machaeranthera and Hesperastrum were selected as an appropriate doctoral systematic problem by Mr. Larry Gieschen. After several years of field and herbarium studies he suddenly abandoned this project with the observation that "The past is fiction..", a quotation which he said was taken somewhere from the current writings of William Burroughs. To me, his major professor, however, the "past" meant that some 12,000 plus plant specimens on loan to the University of Texas from 20 or more herbaria had to be annotated and returned. To this end I invested some 6 months of my time during the spring and summer of 1986, with 6 weeks and 8000 miles of field work in the western U.S. during the late summer and fall months.

After working with the herbarium sheets and distilling from these a body of data which suggested that relatively few recognizable specific taxa made up the sections concerned (in spite of the 70 or more specific names proposed), I was pleased to have these concepts confirmed by subsequent field observations.

My studies suggest that the section Machaeranthera has but two partially sympatric species, M. tagetina and M. tanacetifolia, the former occurring at lower elevations in the Sonoran desert regions, the latter occurring at higher more mesic sites over a much broader area. If in close proximity occasional hybrid swarms will be found, along with some peripheral gene flow.

The section Hesperastrum is much more difficult. In this I recognize but three species: 1) M. asteroides, predominantly in the lower more arid regions of the southwestern United States and adjacent Mexico; 2) M. bigelovii, predominantly of high elevations in the south-central Rocky Mountain regions of the United States and; 3) M. canescens, a wide-ranging highly variable species of the north-central and western Rocky Mountain Regions. The latter is

comprised of ten, largely allopatric, morphological entities that intergrade peripherally, either geographically or up-slope (where such varieties occupy the same montane massifs).

Finally, I do not contend that the views expressed here are etched in stone. Additional field work is needed to help clarify the spatial relationships of *M. tagetina* and *M. tanacetifolia* in southern Arizona and those of *M. asteroides* and *M. bigelovii* in southern New Mexico. In addition there appears to be occasional intergradation of *M. canescens* and *M. bigelovii* in Colorado. Whether this is occasioned by recent or ancestral hybridization is a question that might be resolved with populational analyses. I do, however, believe that most of the basic variation patterns and distributions documented here, and the names bestowed upon them, will weather the test of time and additional study.

SPECIES RELATIONSHIPS

The relationship of the two species recognized in section *Machaeranthera* seem fairly straight-forward. The large-headed, much more widespread, *M. tanacetifolia*, apparently gave rise to the small-headed relatively localized *M. tagetina* in relatively recent time, perhaps within the last 100,000 years or so, as the Sonoran desert became regional in scope. Whether or not the character-intergradations that can be found in the Arizona region is due to environmental sorting (primary divergence), or to gene flow following secondary peripheral contact, or to occasional instances of sympatric hybridization, was not resolved by this study.

Relationships among the section *Hesperastrum* are much more complex. I have recognized three species, each of which contains three or more infraspecific taxa which I have treated as varieties because their ranges are largely allopatric and each appears to intergrade in areas of contact with yet other varieties.

I am relatively content that *Machaeranthera canescens* with its ten, mostly intergrading, varieties is a natural or phyletic-grouping. I am less sure about the relationships within *M. bigelovii*, for this subalpine taxon appears to be quite variable, either as a result of periodic hybridization with the lower-elevational, *M. canescens*, or as a result of parallel selection for larger heads with more attenuate involucre bracts and capitulescences with more extensive glandular-trichomes. Indeed, the populational units from south-central Utah which I have referred to as *M. bigelovii* var. *commixta* might as readily be included as a variety under *M. canescens*. I opted for the former course because it occupied fairly subalpine habitats, and possessed some of the key-characters of *M. bigelovii* (i.e., well-developed, glandular-trichomes upon its peduncles and involucre bracts). But in other characters, e.g. smaller heads with fewer florets, less-attenuate involucre bracts, etc. it strongly approaches *M. canescens*. So future workers might help resolve this minor

evolutionary enigma: are these subalpine populations selected out of the variable, widespread, M. canescens so that they superficially resemble M. bigelovii as it is typically represented in Colorado and northern New Mexico, or do these represent relict populations of a once more widespread and perhaps variable M. bigelovii.

Within Machaeranthera asteroides I have also recognized three varieties: 1) a montane, widespread var. asteroides which appears to intergrade locally with M. bigelovii in southern New Mexico, presumably as a result of sympatric hybridization with some peripheral gene-flow; 2) a less-montane desert or semi-desert var. glandulosa, which possibly arose out of ancestral hybridization between M. asteroides and M. cinerascens; and 3) the localized var. lagunensis, which presumably also relates to ancestral gene exchange between M. asteroides and M. cinerascens, with subsequent divergence.

Additional comments regarding the above observations will be found below each of the taxa mentioned.

SECTIONAL RELATIONSHIPS

Machaeranthera and Hesperastrum are believed to be closely related taxa. They share numerous morphological features, possess similar flavanoids, and are all characterized by the diploid chromosome number, $2n=8$. The two sections are most readily distinguished by their vegetative features, Machaeranthera by its pinnately dissected leaves and Hesperastrum by its merely dentate, serrulate, or occasional entire leaves.

Of the approximately 14,000 herbarium sheets examined in the present study and from the numerous populations examined in the field, hybridization between members of these two sections was inferred from only a single collection (Colorado: "Rocky Mts.", Hall & Harbour 285, US, collected in the year 1862). This plant appeared to be intermediate between M. tanacetifolia and M. bigelovii. Future workers might anticipate the rare hybrid where these two species occur together.

As to the relationship of the above two sections with yet other sectional groupings within Machaeranthera I refer the readers to the upcoming cladistic analysis by Nesom and Turner (1987). It is sufficient to say at this point that the cladistic (and phenetic) relationships among the various sections of Machaeranthera (sensu Hartman) and yet other genera (e.g., Isocoma) are much more reticulate than heretofore suspected.

CHROMOSOME COUNTS

The first published chromosome count for a member of the sect. Hesperastrum was presumably an erroneous count of $n=5$ for

Machaeranthera canescens var. *canescens* (reported as *M. leucanthemifolia* by Raven et al., 1960). As noted in Table 1, all subsequent counts (from about 80 populations) have been diploid with $n=4$.

Jackson (1959) was the first to report counts for the sect. *Machaeranthera*. This, and all subsequent reports on populations of this taxon, have been diploid with $n=4$. Gieschen (unpubl., Table 1) has made the most extensive chromosomal survey of the above two sections, providing numerous counts from nearly all of the included taxa. Species in both sections are relatively easy to count from meiotic material, but occasional plants may possess 1-3 fragments which probably accounts for the erroneous report for *M. canescens*, noted above.

In summary, sections *Machaeranthera* and *Hesperastrum* have been found to be uniformly diploid on a base of $x=4$. A base chromosome of $x=4$ has also been reported for other sections of *Machaeranthera*, except for species of the section *Arida* which have a base number of $x=5$ (Hartman, 1976). Chromosome numbers of $2n=4$ and $2n=6$ found in *M. gracilis* (Jackson, 1964) of the section *Sideranthus* and $2n=6$ in *M. heterocarpa* Hartm. & Lane of the section *Psilactis* (Hartman and Lane, 1987) are believed to be aneuploid derivatives. The latter taxon also contains species with $2n=18$ (Hartman, 1976; Nesom 1978), but these are believed to be polyploid derivatives from ancestral base numbers of $x=4$ or 5.

TABLE 1. Chromosome numbers in Sections *Machaeranthera* and *Hesperastrum*.

<u>Taxon</u>	<u>Locality</u>	<u>Reference/voucher</u>	<u>Number</u>
SEC. <i>HESPERASTRUM</i>			
<i>M. asteroides</i>			
var. <i>asteroides</i>			
"	MEX. Chihuahua:	Powell et al 1304 (TEX)	$n=4$ II
"	USA. ARIZ: Greenlee Co.,	Gieschen 42 (TEX)	$n=4$ II
"	USA. ARIZ: Pinal Co.,	Gieschen 42 (TEX)	$n=4$ II
"	USA. N.MEX: Hidalgo Co.,	Ward (1984)	$n=4$ II
	[reported as <i>M. tephrodes</i>]		
"	USA. N.MEX: Otero Co.,	Anderson et al. (1974)	$n=5$ II*
	[reported as <i>M. tephrodes</i>]		
<i>M. asteroides</i>			
var. <i>glandulosa</i>			
"	USA. ARIZ: Maricopa Co.,	Pinkava & Keil (1977)	$n=4$ II
	[reported as <i>M. tephrodes</i>]		
"	USA. ARIZ: Maricopa Co.,	Parfitt 2967 (ASU)	$n=4$ II
"	USA. ARIZ: Mohave Co.,	Reeves & Pinkava 11963 (ARIZ)	$n=4$ II
"	USA. ARIZ: Yavapai Co.,	Keil & Pinkava (1979)	$n=4$ II
	[reported as <i>M. bigelovii</i>]		

M. asteroides var. glandulosa cont.

- USA. ARIZ: Yavapai Co., Solbrig et al. (1969) n=4 II
 [reported as M. bigelovii]
 " USA. ARIZ: Gila Co., Gieschen 46 (TEX) n=4 II
 " USA. ARIZ: Greenlee Co., Turner & Powell 6114 (TEX) n=4 II

M. bigeloviivar. bigelovii

- USA. COLO: Chaffee Co., Turner & Flyr (1966) n=4 II
 " USA. COLO: Chaffee Co., Watson (1973) n=4 II
 " USA. COLO: Gilpin Co., Watson (1973) n=4 II
 " USA. COLO: Huerfano Co., Mosquin 5394 (NY) n=4 II
 " USA. COLO: Larimer Co., Gieschen 98, 99 (TEX) n=4 II
 " USA. COLO: Larimer Co., Semple (1985) 2n=8
 " USA. COLO: Larimer Co., Turner & Horne (1964) n=4 II
 " USA. COLO: Park Co., Gieschen 104 (TEX) n=4 II
 " USA. COLO: San Juan Co., Gieschen 108 (TEX) n=4 II
 " USA. COLO: San Juan Co., Watson (1973) n=4 II
 " USA. COLO: Summit Co., Mosquin 5359 (NY) n=4 II
 " USA. COLO: Teller Co., Gieschen 103 (TEX) n=4 II
 " USA. N.MEX: Mora Co., Sundberg 1652 (TEX) n=4 II
 " USA. N.MEX: Otero Co., Hartman 3464 (LL) n=4 II
 " USA. N.MEX: Sandoval Co., Gieschen 117, 118 (TEX) n=4 II
 " USA. N.MEX: Sierra Co., Ward & Spellenberg (1986) n=4 II
 " USA. WYO: Albany Co., Keil 10908 (AZU) n=4 II
 [approaches M. canescens]

M. bigeloviivar. commixta

- USA. UTAH: Iron Co., Gieschen 90, 92 (TEX) n=4 II
 " USA. UTAH: Iron Co., Hartman 3411b (TEX) n=4 II

M. bigeloviivar. mucronata

- USA. ARIZ: Coconino Co., Gieschen 86 (TEX) n=4 II
 " USA. ARIZ: Coconino Co., Keil 11716 (TEX) n=4 II

M. canescensvar. ambigua

- USA. ARIZ: Apache Co., Turner & Horne (1964) n=4 II
 " USA. ARIZ: Coconino Co., Gieschen 84, 85 (TEX) n=4 II
 " USA. ARIZ: Coconino Co., Keil 11734, Keil (1979) n=4 II
 " USA. ARIZ: Coconino Co., Morefield 1766a (NY) n=4 II
 [reported as M. tephrodes in Morefield & Schaack, 1985]
 " USA. N.MEX: Santa Fe Co., Mosquin & Gillett 5413 (NY) n=4 II**

M. canescensvar. aristata

- USA. ARIZ: Coconino Co., Solbrig et al. (1964) n=5 II
 [reported as M. rigida]
 " USA. ARIZ: Coconino Co., Turner & Horne (1964) n=4 II
 [reported as M. linearis]

M. canescens var. aristata cont.

	USA. ARIZ: Navajo Co.,	Turner & Horne (1964)	n=4 II
"	USA. N.MEX: San Juan Co.,	Ward (1984)	n=4 II
"	USA. UTAH: Grand Co.,	Gieschen 95 (TEX)	n=4 II
"	USA. UTAH: Kane Co.,	Turner 5834 (TEX)	n=4 II
"	USA. UTAH: San Juan Co.,	Turner 5840 (TEX)	n=4 II

M. canescensvar. canescens

	CANADA. Alberta:	Mosquin & Benn 4728 (DS)	n=4 II
"	USA. CALIF: Alpine Co.,	Gieschen 65 (TEX)	n=4 II
"	USA. CALIF: Alpine Co.,	Solbrig et al. (1969)	n=4 II
	[reported as <u>M. shastensis</u>]		
"	USA. CALIF: Inyo Co.,	Gieschen 59 (TEX)	n=4 II
"	USA. COLO: Grand Co.,	Gieschen 97 (TEX)	n=4 II
"	USA. COLO: Gunnison Co.,	Gieschen 105 (TEX)	n=4 II
"	USA. COLO: Montrose Co.,	Gieschen 106 (TEX)	n=4 II
"	USA. COLO: Saguache Co.,	Watson (1973)	n=4 II
"	USA. COLO: Saguache Co.,	Watson (1973)	n=4 II
	[intermediate to <u>M. bigelovii</u> ; reported as <u>M. aspera</u>]		
"	USA. IDAHO: Fremont Co.,	Solbrig et al. (1969)	n=4 II
	[reported as <u>M. commixta</u>]		
"	USA. NEV: Clark Co.,	Gieschen 53 (TEX)	n=4 II
	[intermediate to var. <u>leucanthemifolia</u>]		
"	USA. NEV: Clark Co.,	Gieschen 52 (TEX)	n=4 II
	[approaches var. <u>leucanthemifolia</u>]		
"	USA. NEV: Clark Co.,	Raven et al. (1960)	n=5 II*
	[reported as <u>M. leucanthemifolia</u>]		
"	USA. NEV: White Pine Co.,	Solbrig et al. (1969)	n=4 II**
	[reported as <u>M. commixta</u>]		
"	USA. NEV: White Pine Co.,	Turner & Horne (1964)	n=4 II
	[reported as <u>M. commixta</u>]		
"	USA. UTAH: Iron Co.,	Gieschen 89 (TEX)	n=4 II
"	USA. UTAH: Sevier Co.,	Sundberg 2004 (TEX)	n=4 II
"	USA. UTAH: Utah Co.,	Gieschen 80 (TEX)	n=4 II
"	USA. WYO: Sweetwater Co.,	Turner & Horne (1964)	n=4 II
	[reported as <u>M. commixta</u>]		
"	USA. WYO: Uinta Co.,	Solbrig et al. (1969)	n=4 II
"	USA. WYO: Washakie Co.,	Watson (1973)	n=4 II

M. canescensvar. leucanthemifolia

	USA. ARIZ: Coconino Co.,	Solbrig et al. (1964)	
	[reported as <u>M. canescens</u>]		
"	USA. CALIF: Inyo Co.,	Morefield 1603a (NY), 1654a (NY), 1738a (NY)	n=4 II
	[reported in Moorefield & Schaack, 1985]		
"	USA. NEV: Clark Co.,	Gieschen 54 (TEX)	n=4 II
"	USA. NEV: Clark Co.,	Solbrig et al. (1960)	n=4 II
"	USA. NEV: Esmeralda Co.,	Gieschen 56 (TEX)	n=4 II
"	USA. NEV: Esmeralda Co.,	Strother (1972)	n=4 II
	[reported as <u>M. canescens</u>]		

M. canescens var. leucanthemifolia cont.

USA. NEV: Nye Co., Solbrig et al. (1969) n=4 II
[reported as M. canescens]

M. canescensvar. nebraskana

USA. NEB: Turner 15664 (TEX) n=4 II**

M. canescensvar. shastensis

USA. CALIF: Siskiyou Co., Semple 5710 (NY) 2n=8
" USA. CALIF: Lake Co., Strother (1972) n=4 II

SEC. MACHAERANTHERAM. tagetina

USA. ARIZ: Pima Co., Sundberg & Hardison 2116 n=4 II
" USA. N.MEX: Hidalgo Co., Jackson (1960) n=4 II

M. tanacetifolia

USA. ARIZ: Santa Cruz Co., Pinkava & Kiel (1977) n=4 II
[reported as M. tagetina]
" USA. ARIZ: Santa Cruz Co., Pinkava & Kiel (1977) n=4 II
[reported as M. tagetina]
" USA. COL: Weld Co., Solbrig et al. (1969) n=4 II
" USA. N.MEX: Dona Ana Co., Pinkava & Kiel (1977) n=4 II
" USA. N.MEX: Eddy Co., Solbrig et al. (1964) n=4 II
" USA. N.MEX: Otero Co., Gieschen 33 (TEX) n=4 II
" USA. N.MEX: Socorro Co., Jackson (1959) n=4 II
" USA. N.MEX: Union Co., Watson (1973) n=4 II
" USA. N.MEX: Valencia Co., Ward & Spellenberg (1986) n=4 II
" USA. TEX: Midland Co., Solbrig et al. (1969) n=4 II
" USA. TEX: Reeves Co., Powell & Powell (1977) n=4 II
" USA. TEX: Reeves Co., Solbrig et al. (1964) n=4 II
" USA. UTAH: Emery Co., Anderson et al. (1974) n=4 II
" USA. WYO: Platte Co., Hartman (1976) n=4 II
" MEX. Chihuahua: DeJong & Longpre (1963) n=4 II
" MEX. Chihuahua: Lewis 214 (LL) n=4 II
" MEX. Chihuahua: Turner et al. (1962) n=4 II
" MEX. Durango: Turner et al. (1962) n=4 II
" MEX. Nuevo Leon: Turner et al. (1961) n=4 II

* probably an erroneous count

** with 1-3 fragments

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MACHAERANTHERA Nees, Gen. & Sp. Asterearum p. 224. 1832.

Chrysopsis subg. Pappochroma Nutt. = Machaeranthera subg. Machaeranthera

Haplopappus sect. Blepharodon DC.

Dieteria Nutt. = Machaeranthera sect. Hesperastrum A. Gray

Eriocarpum Nutt. = sect. Blepharodon DC.

Psilactis A. Gray = Machaeranthera sect. Psilactis (A. Gray) Turner & Horne

Haplopappus sect. Eriocarpaea Benth. & Hook.

Aster sect. Machaeranthera (Nees) Benth. & Hook. = Machaeranthera sect. Machaeranthera

Aster sect. Hesperastrum (A. Gray) A. Gray = Machaeranthera sect. Hesperastrum A. Gray

Aster subg. Hesperastrum (A. Gray) A. Gray = Machaeranthera subg. Hesperastrum A. Gray

Sideranthus (Nutt. ex Walpers) Rydb.

Haplopappus sect. Havardii R. C. Jackson

Tap-rooted, or rarely rhizomatous, annual, biennial or perennial herbs (rarely suffruticose) 2-120 cm high, glabrous to variously pubescent. Leaves alternate, simple to pinnately dissected, the margins entire, dentate or lobulate, the enations usually with minute or prominent apical bristles. Heads hemispheric to turbinate. Involucre 2-12 seriate, imbricate to subimbricate; bracts linear, appressed or reflexed, often prominently so, the appendages usually green and foliaceous, in contrast with the appressed indurate bases. Receptacle naked or "paleate", plane to convex, usually alveolate and glabrous. Ray florets 8-numerous in 1-3 series, pistillate and fertile (rarely neuter), sometimes absent; corollas variously purple or yellow, sometimes white. Disk florets 10-numerous, perfect and fertile; corollas yellow, tubular or gradually flaring, the tube only rarely sharply differentiated from the throat, the lobes 5. Anther appendages eglandular, ovate to narrowly ovate. Style branches with well-defined, acute to subulate, prominently hispid appendages. Achenes of disk and ray florets more or less similar (in sect. Psilactis the ray pappus usually absent), the body usually obovate, subfalcate to somewhat clavate, the walls thick or thin, with 4-9 prominent or obscure ribs, glabrous to pubescent with a small circular carpopod; pappus of 20-50 persistent ciliate bristles in 1-3 series, either the same length or much-graduated. Base chromosome number $x=5$ or 4 (the lower or higher numbers being derived by aneuploidy or polyploidy).

Type species, M. tanacetifolia (H.B.K.) Nees.

A wholly North American genus largely confined to the deserts and grasslands of the Western United States and adjacent Mexico.

Hartman (1976) treated the group as comprised of two subgenera: 1) Machaeranthera with five sections (Machaeranthera,

Blepharodon, Hesperastrum, Arida and Psilactis); and 2) Sideranthus with three sections (Sideranthus, Havardii and Stenoloba). I have followed this treatment believing this to be the best recent published account. However, Hartman and Lane (1986; pers. comm.) intent to remove the section Blepharodon (white rayed or rayless) and all of the subgenus Sideranthus (yellow-rayed) from Machaeranthera, returning this to Haplopappus, albeit in a much more restricted sense than conceived by Hall (1928).

Key to species of Sections Machaeranthera and Hesperastrum

1. Leaves manifestly dissected or deeply lobed
(2) Sect. Machaeranthera
1. Leaves entire or irregularly dentate (3). Sect. Hesperastrum
 2. Heads hemispheric; involuclral bracts 50-80; corolla lobes glabrous or nearly so (widespread) 1. M. tanacetifolia
 2. Heads broadly turbinate; involuclral bracts 20-40; corolla lobes manifestly pubescent (S. Arizona and closely adjacent areas) 2. M. tagetina
3. Involuclral bracts and peduncles well-endowed with prominent glandular-trichomes 0.2-0.8 mm long; mostly subalpine plants of Colorado and N. Mex 4. M. bigelovii
3. Involuclral bracts canescent to appressed pubescent, or variously short-glandular but rarely with prominent glandular trichomes on both peduncles and bracts (4)
 4. Involuclral bracts linear-subulate, usually pubescent throughout; mid-stem leaves usually 0.8-2.0 cm wide. - Mostly mid-elevational plants from montane areas of New Mexico, S and W Arizona, S Calif. and adjacent areas of Mexico. 3. M. asteroides
 4. Involuclral bracts acute to merely subulate, only rarely pubescent throughout (in var. nebraskana, glabra and ambigua); mid-stem leaves usually 0.2-0.6(0.8) cm wide. Mostly north of the above taxon, ranging from lowland deserts to subalpine habitats 5. M. canescens

Subgenus Machaeranthera

Chrysopsis subg. Pappochroma Nutt., J. Acad. Nat. Sci. Phila. 7: 34. 1834. Type species: Chrysopsis coronopifolia Nutt.

Dieteria subg. Pappochroma (Nutt.) Nutt., Trans. Amer. Phil. Soc. II, 7: 302. 1840.

Aster subg. Hesperastrum (A. Gray) A. Gray, Proc. Amer. Acad. Arts 16: 97. 1881.

Machaeranthera subg. Dieteria (Nutt.) Greene, Pittonia 3: 59. 1896.

Section 1. Machaeranthera

Dieteria sect. Pappochroma (Nutt.) Walpers, Rep. Bot. Syst. 2: 587. 1843.

Aster sect. Machaeranthera (Nees) Benth. & Hook., Gen. Pl. 2: 272. 1873.

Machaeranthera series Verae Cronq. & Keck, Brittonia 9: 238. 1957. Type species: Machaeranthera tanacetifolia H.B.K. Nees.

Tap-rooted annuals or biennial herbs, 1-6 cm high. Leaves deeply dissected, pinnatifid to bipinnatifid. Heads radiate. Involucres hemispheric to turbinate. Phyllaries in 3-12 imbricate or subimbricate series, linear, the lower portion indurate with a midline, the upper 1/4-3/4 green, variously pubescent, widely divergent to reflexed, rarely appressed, acute, abruptly acuminate to long-attenuate. Receptacles alveolate. Ray florets pistillate, fertile, usually strongly violet-blue. Achenes narrowly obovate, flattened laterally, the walls moderately thick with 4-9 pronounced ribs per face, moderately pubescent. Achenes similar in ray and disc florets, the pappus white or tawny, the bristles mostly filiform, not basally flattened, in 1-3 poorly defined series. Base chromosome number, $x=4$.

1. MACHAERANTHERA TANACETIFOLIA (H.B.K.) Nees, Gen. & Sp. Asterearum, p. 225. 1832.

Aster tanacetifolius H.B.K., Nov. Gen. & Sp. 4: 95. 1820. TYPE: MEXICO. "Colitur in horto Mexicano", w/o date, Humboldt s.n. (phototype GH!; possible isotype B!; photoisotype TEX!).

Aster chrysanthemoides Willd. ex Spreng., Caroli Linnaei Syst. Veg. 3: 538. 1826. based upon the above.

Chrysopsis coronopifolia Nutt., J. Acad. Nat. Sci. Phila. 7: 34. 1834. TYPE: U.S.A. N. Dak.: "Towards the sources of the Missouri" (probably near Ft. Mandon), Jul-Aug 1811, Nuttall s.n. (isotype GH!; probable isotype NY!).

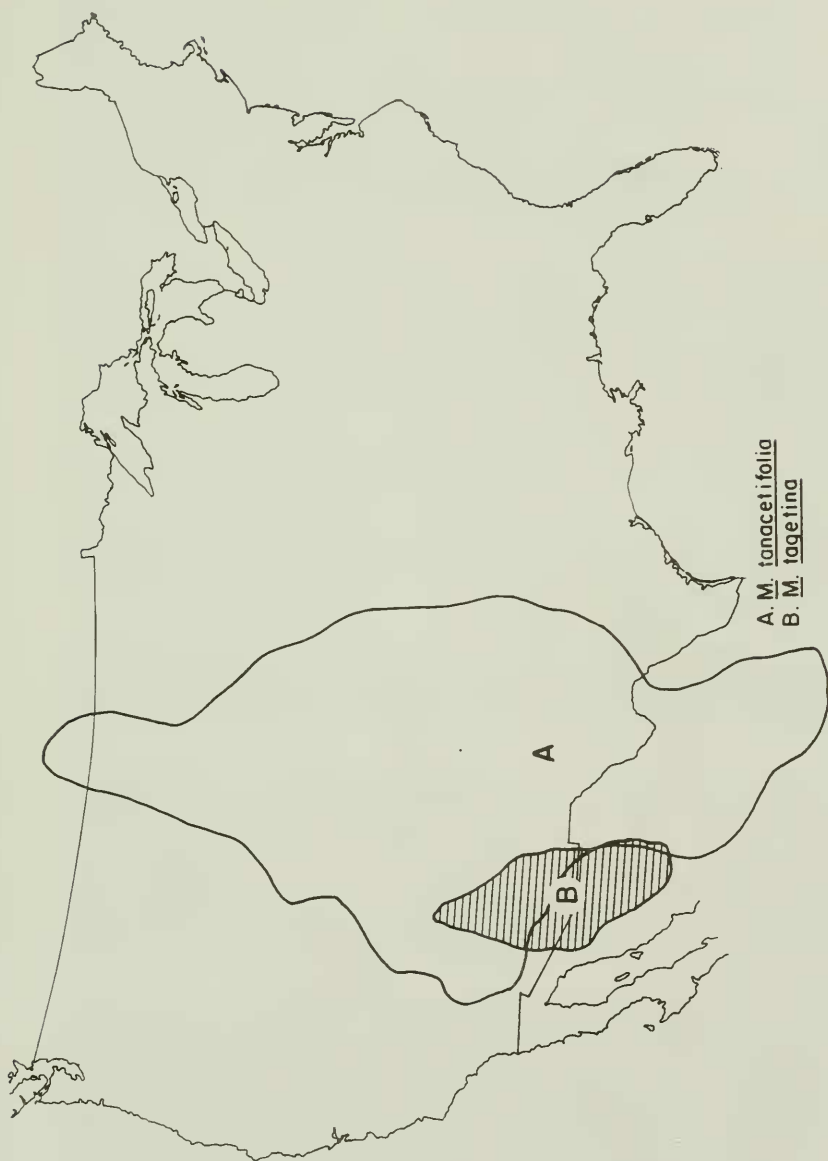


Fig. 1. Distribution of Machaeranthera tanacetifolia and M. tagetina.

Dieteria coronopifolia (Nutt.) A. Gray, Trans. Amer. Phil. Soc. II, 7: 302. 1840.

Aster pinnatifidus Sesse & Moc., Fl. Mex. 2: 205. 1892.

TYPE: MEXICO. Sinaloa: hot, dry fields, Sep w/o year, Sesse et al. 2076 (holotype M; phototype TEX!).

Machaeranthera parthenium Greene, Pittonia 4: 99. 1899.

TYPE: U.S.A. Arizona: Pima Co., Davidson Canyon, Empire Mts., 10 Sep 1884, Pringle s.n. (lectotype ND; isolectotypes CAS!, F!, GH!, NY!, PHIL!, UC!, US!, WS!).

Machaeranthera coronopifolia (Nutt.) A. Nels., Bot. Gaz. 37: 268. 1904.

Erect annual or biennial, puberulent to viscid glandular, herbs 10-70 cm high. Leaves lacinate, mostly 3-12 cm long, 1-4 cm wide, once or twice pinnatifid, the lobes minutely spinulose. Heads few (to numerous when branched from the base), broadly turbinate to hemispheric; involucre bracts 30-70, puberulent to puberulent-glandular, 3-5 seriate, imbricate to subimbricate, indurate below the apices, usually leafy and reflexed for 1/2 their length. Receptacle convex, alveolate, 5-9 mm across. Ray florets (21)34-150, pistillate, fertile; ligules lavender, purple to blue, 1-2 cm long, 1.0-1.8 mm wide. Disk florets numerous; corollas yellow, tubular, 5-7 mm long, the limb glabrous, the lobes ca 0.5 mm long, glabrous or nearly so. Achenes obovate with 4-6 ridges on a face, 3-4 mm long, 1.0-1.5 mm wide, moderately appressed sericeous; pappus of 40-60, white, persistent, ciliate bristles mostly 4-6 mm long.

Chromosome number, $2n=8$.

DISTRIBUTION (Fig. 1): widespread in the drier mostly grassland regions of the Rocky Mountains from Montana to southcentral Mexico, mostly in loose gravelly or sandy soils. Flowering: (Jun) Jul-Oct.

In spite of its widespread distribution the species is remarkably uniform. It does tend to vary between and within populations in habit, leaf dissection and vestiture, more notably in Arizona where it is thought to hybridize with M. tagetina (for discussion see below). Very rare hybrids with M. bigelovii might also occur (e.g., Colorado, Rocky Mts., Hall & Harbour 285, US) and at least one sheet (Langman 4067, PHIL) from Zacatecas Mex, be a rare hybrid between M. tanacetifolia and the yellow-rayed M. pinnatifida).

REPRESENTATIVE SPECIMENS: MEXICO. Aguascalientes: ca Margaritas, along highway 45, 10 Aug 1970, Mears 3523. Chihuahua: Chihuahua, 3-4 Sep 1935, Le Sueur 57 (GH, LL, MO, UC, TEX). Coahuila: 20 mi NW Hacienda La Babia, 3 Jul 1936, Wynd & Mueller 440 (ARIZ, GH, MO, NY, TEX, US). Durango: 13 mi N Durango, 17 Aug 1960, King 3754 (DS, NY, TEX, UC, US). Nuevo Leon: Munic. de Derrumbadera, Hacienda San Jose de Raices, 5 Aug 1935, Mueller 2358 (GH, MO, TEX). San Luis Potosi: Catorce, Sierra de Catorce, 24-25

Jul 1934, Pennell 17601 (GH). Zacatecas: near Concepcion del Oro, 11-14 Aug 1904, Palmer 302 (GH, MO, NY, UC, US).

UNITED STATES. ARIZONA: Apache Co.: Window Rock, 28 Aug 1964, Turner 5104 (TEX). Cochise Co.: 6000 ft, 17 Oct 1906, Blumer 1482 (ARIZ, F, NY, US). Coconino Co.: 35 mi E. Flagstaff, 2 Sep 1943, Schallert s.n. (GH, PH, RM, TEX). Gila Co.: Cibecue Ridge, 5400-5600 ft, 21 Aug 1968, Granfelt 68-273 (ARIZ). Graham Co.: 20 mi SE Safford, 17 May 1936, Maguire 11429 (GH, NY, RM, UC, WS). Maricopa Co.: 20 km NE Diamond Peak, 1200 m, 11 Jul 1982, Baker 4508 (ASU). Mohave Co.: 14 mi W Kingman, 2900 ft, 8 May 1964, Cronquist 9946 (GH, NY, UTC, WTU). Navajo Co.: Holbrook, 15 Oct 1897, Zuck s.n. (CAS, NY, UC). Pima Co.: Davidsons Canyon, 10 Sep 1884, Pringle s.n. (F, NDG, NY, PHIL, WS). Pinal Co.: Sacaton, 7 Apr 1916, Hasting's & Thornber 9009 (ARIZ). Santa Cruz Co.: Nogales, 22 Oct 1926, Jones 22671 (MO, POM). Yavapai Co.: near Prescott, 1-5 Sep 1929, Kusche s.n. (CAS, DS, LL, UC). Yuma Co.: Gila Valley 300 ft, Jul 18974, Rothrock 330 (F).

CALIFORNIA: San Bernadino Co.: New York Mts, 5500 ft, 30 Aug 1973, Henrickson 12712 (ASU, LL, NY).

COLORADO: Adams Co.: 10 mi E Brighton, 16 Jun 1937, Ramaley & Gambill 16083 (MONT, POM, RM). Archuleta Co.: Pagosa Springs, 30 Jun 1921, Bethel s.n. (CS). Baca Co.: 40 mi SW Springfield, 7 Jun 1972, Feddema 4419 (RM). Boulder Co.: 8 mi E. Boulder, 5 Jun 1913, Vestal s.n. (DS). Chaffee Co.: Salida, 11 Jul 1910, Eggleston 5926 (NY, US). Clear Creek Co.: Below Gray's Peak, 10 Aug 1871, Smith s.n. (NY, PHIL). Costilla Co.: 30 mi NE Alamosa, 8 Sep 1934, Ramaley 14480 (RM). Cheyenne Co.: 3 mi S Aroya, 2 Aug 1961, Harris 129 (CS). Crowley Co.: 4 mi W Olney Springs, w/o date, Lane s.n. (CS). Denver Co.: Denver, 10 Jun 1878, Jones 189 (NY, POM, UTC). El Paso Co.: 4 mi S Palmer lake, 7 Aug 1941, Waterfall 3200a (GH). Fremont Co.: between Fountain and Canon City, 20 Jul 1872, Redfield 476 (NY). Huerfano Co.: Walsenberg, 11 Jun 1912, Vestal 391 (DS). Larimer Co.: Fort Collins, 8 Jul 1884, Sheldon 13 (NY, PHIL). Las Animas Co.: Trinidad, 13 Jun 1916, Eastwood 5557 (CAS). Lincoln Co.: plains at Hugo, 17 Aug 1875, Patterson s.n. (F). Mesa Co.: Colorado National Monument, 11 Sep 1968, Porter & Porter 10595 (UC). Montrose Co.: Naturita, 11 Aug 1914, Payson 598 (F, GH, RM, WS). Otero Co.: E of La Junta, 3 Sep 1941, Drovet et al. 4075 (F, UC, WTU). Prowers Co.: 1 mi N Carlton, 3 Aug 1967, Davis D-35 (CA, DAV). Pueblo Co.: plains about Pueblo, 1 Sep 1882, Woodward s.n. (GH, UTC). Saguache Co.: Maria Baca Grant - Duncan, 15 Sep 1939, Gierisch 1195 (NY, RM). Washington Co.: Sandhill Native range, 25 Jul 1957, Dahl 14 (CS). Weld Co.: New Windsor, 6 Jun 1901, Osterhout s.n. (NMU, NY, POM, UC). Yuma Co.: Bonny Reservoir, 18 Aug 1961, Lemaire 1457 (NEB).

ILLINOIS: Adam's Co.: Quincy, Sep 1917, Beckwith 53 (F).

KANSAS: Clark Co.: Englewood, Sep 1891, Carleton 526 (ARIZ, US). Ellis Co.: Sandy fields, 1895, Hitchcock 241 (GH, NY, RM, US). Ford Co.: Dodge City, 14 Jun 1903, Grant 5804 (CAS, UC). Grant Co.: Ulysses, 27 Jun 1893, Thompson 47 (US). Greely Co.: Tribune, 24 Aug 1892, Reed s.n. (UC). Hamilton Co.: 5 mi E Syracuse, 16 Aug 1950, Fearing & Latham s.n. (GH, TEX). Kearney Co.: 10 mi W Lakin, 24 Jun 1966, Croat 2086 (GH, MO). Meade Co.: Meade Center, 26 Jun 1888, Kellerman s.n. (US). Morton Co.: N of Elkhart, 12 Jul 1929, Rydberg & Imler 950 (NY). Seward Co.: 20 mi NE Liberal, 11 Jul 1929, Rydberg & Imler 860 (NY). Wallace Co.: Wallace, 22 Aug 1885, Letterman s.n. (NY, OSC, TEX, WS).

MONTANA: Custer Co.: Miles City, 4 Jun 1937, Roberts 935 (MONT). Dawson Co.: Colgate, near Glendive, 6 Sep 1892, Sandberg et al. 1017 (DS, NY, US). Rosebud Co.: 8 mi E Birney, Jul 1957, Bennett s.n. (DS, F, NY, UC). McCone Co.: South Fork of Rock Creek River, 29 Jun 1978, Lackschweitz 8267 (MONTU). Musselshell Co.: Gage, 14 Jun 1937, Lackey 644 (MONTU). Wheatland Co.: 6 mi NE Shawmut, Aug 1934, Hitchcock 2425 (CAS, DS, MONT, POM, RSA, WTU). Yellowstone Co.: E of Billings, 6 Jul 1934, Rose 329 (MONT, MONTU, WS).

NEBRASKA: Chase Co.: SE of Enders, 8 Aug 1941, Tolstead s.n. (NEB). Dawes Co.: Crawford, 16 Jun 1897, Bates s.n. (GH, NEB, RM). Duel Co.: "sandy soil", Jul 1890, w/o collector (US). Dundy Co.: Benkelman, 28 Jul 1916, Bates 416 (NEB). Lincoln Co.: North Platte, 1 Aug 1902, O'Gara s.n. (NEB). Scotts Bluff Co.: Scotts Bluff, 23 Jul 1891, Rydberg 167 (NY, WS). Sioux Co.: near Harrison, Jul-Aug 1927, Kramer 99 (NEB, UT).

NEVADA: Lincoln Co.: 5 air miles NE Panaca, 2 Sep 1982, Shultz & Shultz 6283 (CS, NY, OSU, UTC).

NEW MEXICO: Bernalillo Co.: Sandia Mountains, Tijeras Canyon, 1 Aug 1914, Ellis 454 (NY, US). Catron Co.: 14 mi SW Horse Springs, 11 Aug 1948, Smith 154 (GH, PHIL, US). Chaves Co.: Roswell, Aug 1900, Earle & Earle 328 (NMC, NY, POM, RM, US). Colfax Co.: 1 mi E Springer, 8 Aug 1944, Lucas 127B (LL, TEX). De Baca Co.: 4.3 mi N Taiban, 3 Aug 1967, Secor 47 (TEX). Dona Ana Co.: Mesilla Valley, 6 Jul 1907, Wooton & Standley 3280 (ARIZ, DS, F, MONT, NMC, RM, WS). Eddy Co.: Carlsbad, 3 Oct 1902, Tracy 8162 (F, GH, NDG, NEB, NY, PHIL). Grant Co.: 18 mi NW Silver City, 9 Jun 1903, Metcalf 199 (ARIZ, DS, GH, NMC, NY, POM, RM, UC, US). Guadalupe Co.: vicinity of Santa Rosa, 4 Aug 1926, Arsene & Benedict 16691 (PHIL). Hidalgo Co.: Playas Valley, 4440 ft, 17 Aug 1972, Chiang et al. 8638 (LL). Lea Co.: Lovington, 16 Aug 1940, Fisher 40115 (ARIZ, WS). Lincoln Co.: northern limits of Carizozo, 26 May 1964, Raven 19138 (DS, TEX). Luna Co.: Little Florida Mts, 24 Jul 1919, Abrams s.n. (DS, POM). McKinley Co.: Defiance Trading Post, 19 Sep 1938, Eastwood & Howell 6885 (DS, WU). Otero Co.: 16 mi WSW Alamogordo, 18 May 1983, Soreng 2108 (NMC). Quay Co.: Tucumcari, 19 Jul 1942, Suggs 43 (NMC).

Sandoval Co.: 20 mi SW Cuba, 22 Aug 1979, Pase 2619 (RM, UNM).
 San Juan Co.: ca 30 mi SE Bloomfield, 15 Jul 1972, Hartman & Turner 3400 (LL). San Miguel Co.: Las Vegas to Sante Fe, 3 Sep 1929, Tharp s.n. (F). Santa Fe Co.: 5 mi W Glorieta, 11 Aug 1966, Bennett 8794 (ARIZ, FM). Sierra Co.: 4 mi E Emory Pass, 9 Jun 1965, Crutchfield 174 (LL, NY). Socorro Co.: Socorro, May 1881, Vasey s.n. (DS, F, NY). Torrance Co.: 41 mi W Santa Rosa, 17 Aug 1953, Waterfall 11748 (GH, UC, UNM, TEX). Union Co.: 15 mi W Clayton, 23 Aug 1970, Watson 534 (MONTU, TEX). Valencia Co.: 20 mi S Grants, 18 Aug 1973, Spellenberg 3568 (NMC).

OKLAHOMA: Cimarron Co.: Vacant lot in Kenton, 1 Jun 1947, Goodman 4362 (NY, TEX).

SOUTH DAKOTA: Fall River Co.: 10 mi SW Hot Springs, 16 Jun 1925, McIntosh 685 (RM). Pennington Co.(?): "Badlands" 4 Aug 1950, Petrak & Brencke 50090 (NY).

TEXAS: Andrews Co.: along highway, Sep 1957, Scudday s.n. (LL). Armstrong Co.: Palo Duro Canyon, 17 Jun 1952, Gentry 1321 (TEX). Borden Co.: 5 mi W Gail, 28 Jun 1961, Barclay & Thompson 1036 (LL). Brewster Co.: Boquillas, 17 Apr 1919, Hanson 585 (NY, US). Childress Co.: 8 mi E Memphis, 4 Jun 1973, Higgins 7074 (NY). Comanche Co.: Comanche, Apr 1931, Phipps s.n. (TEX). Culberson Co.: Van Horn, 5 Apr 1936, Sperry T381 (NY, US). Dallam Co.: Dalhart, 24 Jun 1920, Jones 349 (GH). Deaf Smith Co.: 1/4 mi E Glen Rio, 19 Oct 1945, Cory 50372 (DS, GH, NY, UC). Donley Co.: 10 mi S Claredon, 15 May 1944, McCarty 45523 (TEX). Ector Co.: Odessa, 24 Apr 1927, Reed 1913 (US). El Paso Co.: 15 mi E Hueco Mts., Hitchcock et al. 4332 (CAS, DS, GH, UC, UTC, WS, WTU). Floyd Co.: Quitaque-Plainview Rd., 23 Aug 1921, Ferris & Duncan 3372 (CAS). Gaines Co.: 15 mi W Seminole, 20 Jun 1963, La Bonde 173 (POM). Garza Co.: 10 mi W Post City, 5 Oct 1923, Ruth 1133 (US). Hall Co.: 1 mi N Estelline, 21 Jun 1945, Shinners 8000 (GH, MO, NY, RM, TEX, UC, WTU). Hemphill Co.: Canadian, 17 Jun 1918, Palmer 14097 (MO). Hockley Co.: Pep, Jun 1947, Rachaner 137 (TEX). Howard Co.: Big Spring, 9 Sep 1917, Palmer 12476 (F, POM, RM). Hudspeth Co.: 4 mi W Sierra Blanca, 4 Jul 1921, Ferris & Duncan 2476 (CAS, DS, NY). Hutchinson Co.: near Fritch, 12 Aug 1975, Higgins 9669 (BRY). King Co.: 30 mi from Guthrie, 9 Jun 1974, Davis 251 (MO). Lubbock Co.: Caprock, 24 Apr 1930, Demaree 7543 (DS, GH, US). Martin Co.: Stanton, 8 Aug 1926, Tharp 4541 (F, TEX). Midland Co.: 4 mi E Midland, 1 Jun 1964, Raven & Gregory 19216 (DS, TEX). Mitchell Co.: Colorado, 28 May 1918, Palmer 13785 (MO). Ochiltree Co.: 12 mi SE Perryton, 13 Jul 1957, Wallis 4890 (TEX). Oldham Co.: Magenta, 25 Jun 1945, Shinners 8154 (GH). Pecos Co.: Toyah Creek, 21 Apr 1902, Tracy & Earle 92 (F, GH, NDG, NEB, NY, TEX, US). Potter Co.: Canadian River Bridge, 19 May 1945, Jespersen 2680 (DS, F, NY, RM, UC, UTC, WS, WTU). Presidio Co.: Marfa, Jul 1936, Hinckley (F, GH, NY). Randall Co.: Canyon, 12 Jul 1917, Palmer 12519 (F, RM). Reagan Co.: 1 1/2 mi S Big Lake, 24 Apr 1947, Cory 53429 (WS). Reeves

Co.: Pecos, 9 Jun 1931, Gillespie 5250 (DS, GH, UC, US). Roberts Co.: 27 mi S Perryton, 19 Sep 1958, Wallis 7814 (TEX). Sherman Co.: Stratford, 30 May 1931, McKelvey 2475 (GH, POM). Terrell Co.: below Sanderson, 16 Apr 1949, Tharp & Havard 49400 (NDG, TEX). Ward Co.: 1.4 mi S Grandfalls, 9 May 1970, Flyr 1417 (MO). Winkler Co.: 10 mi E Kermit, 13 May 1957, Correll 16358 (LL).

UTAH: Emery Co.: 24 mi N Hanksville, 3 Jun 1961, Cronquist 9190 (GH, NY, RSA, UC, TEX, WS, WTU). Garfield Co.: ca 20 mi SE Escalante, 26 Jun 1965, Holmgren et al. 2054 (NY, TEX, WS, WTU). Grand Co.: 2 mi S Crescent Junction, 20 May 1944, Holmgren 3277 (ARIZ, GH, NY, UTC, UC, WTU). Iron Co.: 6.4 mi SW Lund, 23 Aug 1980, Tiehm 6240 (CAS, MO, NY, RM, RSA, UTC). Kane Co.: 1 mi W Adairville, 5 May 1977, Welsh & Thorne 14699 (NY, RM). San Juan Co.: 38 mi Below Hite, 2 May 1954, Holmgren & Goddard 9959 (CAS, DAV, NY, UC, UTC, WS, WTU). Sevier Co.: NW edge of Walker Flat, 16 Jul 1979, Foster 8267 (BRY, RM). Utah Co.: Orem, 4 Nov 1981, Neese 11165 (BRY, NY). Washington Co.: St. George, 1877, Palmer 211 (F, NY, UC). Wayne Co.: Fruita Arch Canyon, 5 May 1940, Maquire 18122 (UTC, WTU, WS).

WYOMING: Big Horn Co.: 2 mi S and 2 mi W Lovell, 7 Jun 1964, Porter 6 (NY, RM). Campbell Co.: Black Thunder Strip Mining Area, 13 Jul 1973, Ries & Sabinske 29 (RM). Converse Co.: 2 mi E Glenrock, 2 Jul 1935, Williams 2314a (LL, NDG, UC, WTU). Fremont Co.: Dubois, 10 Aug 1894, Nelson 772 (US). Goshen Co.: 10 mi S Torrington, 3 Aug 1940, Ownbey & Gottlieb 611 (RM). Hot Springs Co.: 13 mi N Thermopolis, 15 Jul 1959, Fisser & Porter (RM). Laramie Co.: Guernsey, 26 Jun 1901, Nelson 8266 (RM). Natrona Co.: C. Y. Horse Ranch, 10 Jul 1901, Goodding 231 (DS, F, GH, NEB, NY, RM, UC, US). Niobrara Co.: 0.5 mi N Van Tassell, 21 Jun 1978, Nelson & Ehrmann 1792 (RM). Platte Co.: 3 mi N Wheatland, 9 Jun 1970, Hartman 2972 (ARIZ, NY, UTC). Sheridan Co.: between Sheridan and Buffalo, Jun-Jul 1900, Tweedy 3095 (RM, NY). Washakie Co.: W of Worland, 29 May 1962, Nichols 385 (RM). Weston Co.: near Newcastle, Degener & Peiler 16241 (F, NY, PHIL).

2. MACHAERANTHERA TAGETINA Greene, Pittonia 4: 71. 1899. TYPE: U.S.A. ARIZONA: Cochise Co., near Fort Huachuca, 1891, Wilcox s.n. (holotype US!).

Machaeranthera tanacetifolia var. humilis A. Gray, Pl. Wright. 2: 74. 1853. TYPE: U.S.A. NEW MEXICO: "near Ojo de Gavilan", 1851, Wright 1151 (holotype GH!; isotype GH!). Machaeranthera humilis (A. Gray) Standl., Muhlenbergia 5: 48. 1909.

Aster tagetinus (Greene) S. F. Blake, Contr. U. S. Natl. Herb. 25: 263. 1925.

Erect annual, mostly glandular-puberulent, herbs 5-30 cm high. Leaves once or twice pinnately incised, mostly 2-5 cm long, 1.0-2.5

cm wide, with glandular trichomes above and below, often interspersed with longer eglandular trichomes. Heads broadly turbinate, 5-40 on much-branched plants. Involucre mostly 3-4 seriate, imbricate; bracts mostly 20-34, white, glabrous and indurate below, the apical portions, mostly appressed (rarely reflexing), green and glandular. Receptacle convex, alveolate, mostly 3-5 mm across. Ray florets mostly (8)13-21, pistillate, fertile; ligules 1.0-1.5 cm long, ca 1.5 mm wide, lavender. Disc florets mostly 15-40(50), yellow; corollas 5-7 mm long, tubular, glabrous, except for the lobes which are markedly hispid. Achenes obovate 3-4 mm long 1.0-1.5 mm wide, densely sericeous, the faces with 4-6 ridges; pappus of 80-100 white, 2-3 seriate, ciliate bristles 2-6 mm long.

Chromosome number, $2n=8$.

DISTRIBUTION (Fig. 1): Mostly at lower elevations of the Sonoran Desert in southern Arizona and adjacent Mexico and southwestern New Mexico. Flowering (Jun)Jul-Sep(Oct).

This taxon has been treated as a variety of *Machaeranthera tanacetifolia* by Gray but both Blake (as noted above) and Hartman (1976) accept it as a species. The latter worker, in particular contrasts the turbinate heads and appressed involucre bracts of *M. tagetina* with the hemispheric heads and reflexed involucre bracts of *M. tanacetifolia*.

Nevertheless occasional intermediates between these two taxa occur from over a broad area: e.g., Cochise Co., Lemmon s.n. (GH, UC); Gila Co., Toumey 660 (US); Navajo Co., Eggleston 15842 (US); Pima Co., Brandegge 124 (UC); Pinal Co., Peebles et al. 2468 (LL, US); Yavapai Co., Kearney & Peebles 9737 (ARIZ). Such intermediates are assumed to be putative hybrids, occurring mainly at mid elevations on the aprons of mountain slopes, *M. tanacetifolia* occurring at higher elevations, *M. tagetina* at lower elevations. At least in Cochise County Arizona both taxa have been collected at a single site along with occasional intermediates.

Considering the number of intermediates (only a few of which are cited above) one might opt for varietal treatment. But, if so, each ought to be placed as varieties within subspecific categories since their distinctions are several magnitudes greater than those which delimit the numerous, largely allopatric, varieties of *M. canescens*. Considering all data, I find it taxonomically satisfying to treat these as partially sympatric species which occasionally hybridize. Additional field and experimental studies should attempt to document such hybridization.

REPRESENTATIVE SPECIMENS: MEXICO. Chihuahua: Arroyo Carretas, Carretas, 28 Aug 1938, White 1104 (ARIZ); Municipio de Janos, Carretas, 26-28 Aug 1939, White 2514 (ARIZ, GH). Sonora: between San Pedro and Fronteras. 22-24 Sep 1890, Hartman 950 (GH, UC, US).

UNITED STATES. ARIZONA: Cochise Co.: Fort Huachuca, 12 Sep 1981, Spellenberg 6356 (NY). Coconino Co.: Grand Canyon, near El Tovar, 26-28 Sep 1913, Eastwood 3762 (CAS). Gila Co.: 8 mi NW Roosevelt, Oct-Nov 1951, Dickerman 128 (ARIZ). Graham Co.: 13 mi WNW Duncan, 14 Sep 1976, Norris 3466 (RSA). Greenlee Co.: Blue River, 1 Sep 1902, Davidson 709 (DS, UC). Maricopa Co.: W of Sunflower, 2 Nov 1962, Lehto 1419 (ARIZ). Navajo Co.: 1.75 mi S Whiteriver, 19 Aug 1968, Granfelt 238 (ARIZ, UTC). Pima Co.: Campus, Univ. Arizona, 28 Aug 1903, Thornber 192 (ARIZ, DS, NEB, NMC, NY, POM, UC). Pinal Co.: Oracle, 13 Sep 1935, Shreve 7445 (RSA, UT). Santa Cruz Co.: 3 mi W of Thumb Rock Picnic Area, 6 Sep 1975, Pinkava et al. k11069 (ASU, NY). Yavapai Co.: Beaver Creek, Sep 1903, Purpus (UC, US).

NEW MEXICO: Hidalgo Co.: Animas Mts., Indian Creek Canyon bottom, 13 Sep 1975, Wagner 1571 (UNM); junction IH 10 and N. Mex. 338, sandy edge of Alkali Lake, 22 Sep 1971, Leverich 1014C (TEX).

Section 2. Hesperastrum A. Gray, Proc. Amer. Acad. Arts 6: 539.

1865. Type species: Machaeranthera shastensis A. Gray
Dieteria Nutt., Trans. Amer. Phil. Soc. II, 7: 301. 1840.

Type species: Dieteria canescens Nutt.

Aster sect. Hesperastrum (A. Gray) A. Gray, Syn. Fl. N. Amer.
1(2): 174. 1884.

Machaeranthera series variabiles Cronq. & Keck, Brittonia 9:
237. 1957. Type species: Machaeranthera canescens
(Pursh) A. Gray.

Tap-rooted annuals biennials or short-lived perennials 10-100 cm high. Leaves entire to coarsely serrate or dentate, the teeth usually bristle-tipped. Heads radiate or not so. Involucre turbinate to hemispheric. Phyllaries in 3-12 imbricate to subimbricate series, linear-subulate to broadly oblong, the lower portion usually indurate, the upper 1/3-2/3 green or purple-tinged, glabrous to variously pubescent, erect to reflexed, obtuse to acuminate or long-attenuate. Receptacles convex, alveolate. Ray florets pistillate, fertile, rarely neuter or absent, white to dark blue or purple. Achenes mostly linear to obovate, often asymmetrical (subfalcate), markedly flattened laterally, the walls thin, smooth or obscurely 4-6 nerved, glabrous to moderately pubescent. Achenes similar in ray and disk florets; pappus of white or tawny, filiform, ciliate bristles, not basally flattened, in 1-3 poorly defined series.

Base chromosome number $x=4$.

Key to varieties of M. asteroides

1. Mid-stems markedly glandular-pubescent to nearly glabrous; leaves stiff with harsh

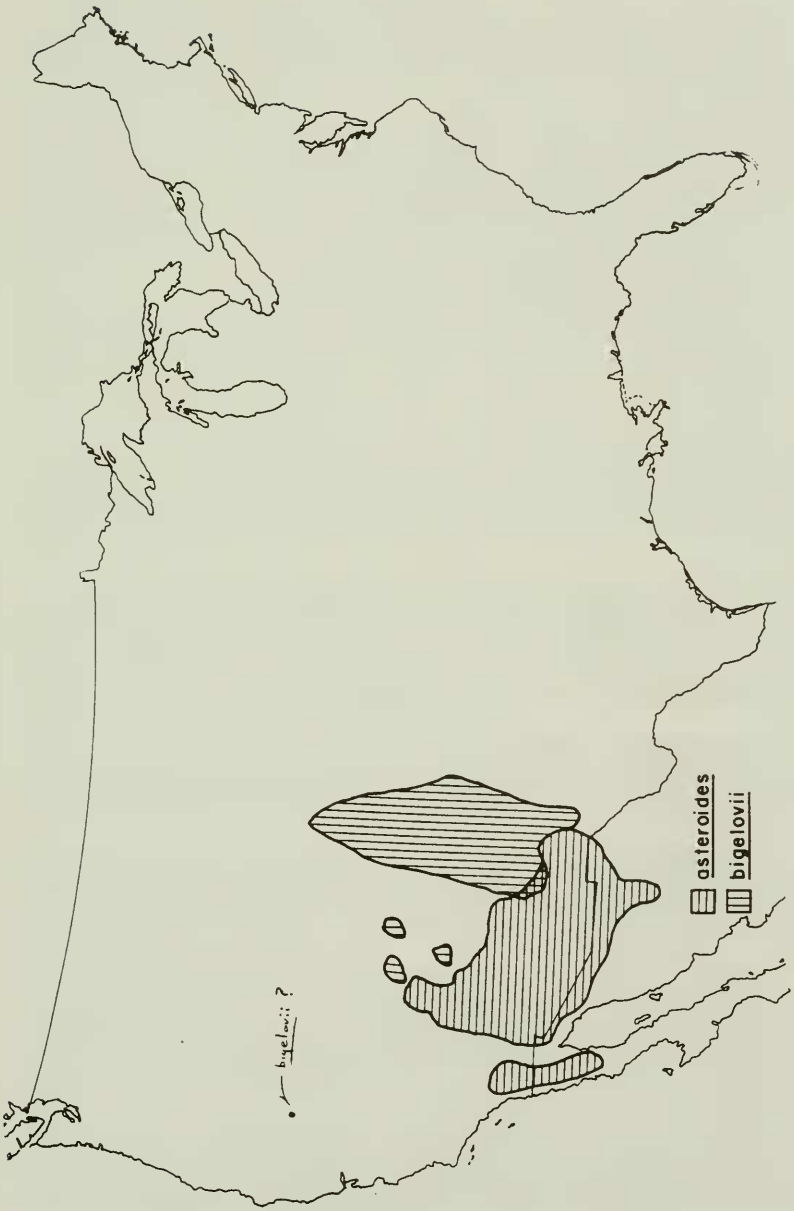


Fig. 2. Distribution of *Machaeranthera asteroides* and *M. bigelovii*.

glandular trichomes (intergrades with var. asteroides) 3b. var. glandulosa

1. Mid-stems canescent, not at all glandular; leaves canescent, soft, without glandular trichomes.
2. Heads hemispheric; apices of involucre bracts narrowly elongate-subulate (3-6 mm long); mid-stem leaves 6-15(25) mm wide, clearly serrulate 3a. var. asteroides
2. Heads broadly turbinate to somewhat hemispheric; apices of involucre bracts acute to shortly-subulate (1-3 mm long); mid-stem leaves mostly 2-5 mm wide, entire to obscurely serrulate 3c. var. lagunensis

3a. Machaeranthera asteroides (Torr.) Greene var. asteroides

Dieteria asteroides Torr., in Emory Report 142. 1848. Machaeranthera asteroides (Torr.) Greene, Pittonia 3: 63. 1892. TYPE: U.S.A. NEW MEXICO (?): "Elevated land between the Del Norte and the waters of the Gila", 16 Oct 1847, Major Emory s.n. (holotype NY!).

Machaeranthera canescens var. latifolia A. Gray, Pl. Wright. 2: 75. 1853. Aster canescens var. latifolia (A. Gray) A. Gray, Syn. Fl. 1²: 206. 1884. TYPE: U.S.A. NEW MEXICO: Grant Co., "Near the Copper Mines" Sep 1851, C. Wright 1152. (Lectotype GH!; isoelectotypes GH!, MO, NY!, PHIL!, UC!, US!).

Machaeranthera pruinosa Greene, Pittonia 4: 157. 1900. TYPE: MEXICO. Chihuahua: Soldiers Canyon, near Casas Grandes, 6500 ft, 11 Oct 1899, C. H. T. Townsend & C. M. Barber 371 (holotype NDG; isotypes GH!, NMC!, NY!, POM!, RM!, TEX!, US!).

Machaeranthera verna A. Nels., Bot. Gaz. 37: 267. 1904. TYPE: U.S.A. ARIZONA: Mohave Co., Virgin River, Big Bend, moist banks, 10 May 1902, L. N. Gooding 757 (holotype RM!; isotypes F!, GH!, NEB!, NY!, POM!, RM!, UC!, US!).

Machaeranthera amplifolia Woot. & Standl., Contr. U.S. Natl. Herb. 16: 187. 1913. Aster amplifolia (Woot. & Standl.) Kittell, in Tidestr. & Kittell, Flora Arizona and New Mexico 406. 1941. TYPE: U.S.A. NEW MEXICO, Dona Ana Co.: Organ Mountains, Filmore Canon, 23 Sep 1906. E. O. Wooton & P. Standley s.n. (holotype US!, Sheet 562446; isotypes NMC!, NY!).

Machaeranthera simplex Woot. & Standl., Contr. U.S. Natl. Herb. 16: 189. 1913. TYPE: U.S.A. NEW MEXICO. Lincoln Co., Capitan Mountains, 2100-2250 m, 31 Aug 1900, F. S. Earle & E. S. Earle 390 (holotype US!; isotypes MO!, NY!, RM!).

Erect biennial or short-lived, usually puberulent, non-glandular, perennial herbs 0-100 cm high. Leaves simple, lanceolate to oblanceolate, mostly 0.5-2.5 cm wide, 3-10 cm long, puberulous above and below, often intermixed with short glandular trichomes, the margins irregularly dentate, gradually tapering (lower leaves) to clasping (upper leaves). Heads usually hemispheric, relatively numerous (2-50); involucre bracts puberulent throughout (rarely intermixed with a few glandular trichomes), 5-12 seriate imbricate to subimbricate, numerous with mostly narrow, tapering, reflexed, elongate-subulate, often apiculate, apices. Receptacle convex, 3.5-6.5 mm across. Ray florets 34-150 pistillate, fertile; ligules purple (drying blue), 1-2 cm long, 0.8-1.5 mm wide. Disk florets numerous; corollas yellow, tubular, 5.5-8.0 mm long, the limb glabrous, the lobes ca 0.4 mm long, pubescent. Achenes somewhat subfalcate, 2.5-3.5 mm long, 0.6-1.1 mm wide, 5-7 striate on each face, glabrous to, less often, sericeous; pappus of 40-50, white or tawny, persistent, ciliate bristles, mostly 6-8 mm long.

Chromosome number, $2n=8$.

DISTRIBUTION (Fig. 2): Northcentral Mexico (Chihuahua) and the adjacent Southwestern United States from New Mexico to southern Arizona and California mostly in dry montane oak-dominated habitats from 1000-2400 m. Flowering: Jul-Oct.

The var. asteroides is distinguished by its usually large hemispheric heads with numerous ray florets, elongate, recurved, mostly eglandular involucre bracts and broad leaves. It superficially resembles M. bigelovii and in south-central New Mexico these appear to intergrade, perhaps through occasional hybridization, either past or present.

In the region of Phoenix Arizona the var. asteroides grades into the more northern var. glandulosa which occurs at lower, drier, elevations and commences to flower in the spring months.

REPRESENTATIVE SPECIMENS: MEXICO. Chihuahua: N end of San Luis Mts., 10 Oct 1982, Spellenberg 6860 (NMC, NY); 1 km al Pominante de Casas Grandes, 1450 m, 23 Oct 1974, Valde VR-755 (LL). Sonora: Canyon Bellota, Sierra Cabellera, 4300 ft, 7-10 Oct 1941, White 4667 (ARIZ, GH, NY).

UNITED STATES. ARIZONA: Apache Co.: 5 mi E Nutrioso, 8500 ft, 28 Aug 1951 (ARIZ, RSA, US). Cochise Co.: Paradise, 1 Oct 1907, 5300 ft, Blumer 1748 (ARIZ, DS, F, GH, MO, NEB, NMC, NY, RM, US). Gila Co.: Pinal Mts. on road from Globe to Clifton, 26 Oct 1928, Eastwood 15879 (CAS, F). Graham Co.: Pinaleno Mountains, 5800 ft, 5 Sep 1944, Darrow et al. 1183 (ARIZ, NY). Greenlee Co.: White Mts., Hannagan Meadow, 9500 ft, 11 Aug 1935, Kearney & Peebles 12353 (ARIZ, F, US). Maricopa Co.: Tempe, along RR track S of 5th Street, E of Roosevelt, 1100 ft, 19 Mar 1978, Reeves 6409 (ASU). Navajo Co.: near White River, 29 Sep 1936, Gunning 4648

(ARIZ, NMC). Pima Co.: Grossetta's Ranch, 2400 ft, 20 May 1903, Thorner 356 (ARIZ, DS, MO, NEB, NMC, NY, POM, UC, US). Pinal Co.: Sacaton, 23 Apr 1926, Peebles et al. 1679 (ARIZ, LL). Santa Cruz Co.: SW of Patagonia, 4000 ft, 24 Sep 1977, Fay 655 (ARIZ). Yavapai Co.: Montezuma Castle, 3200 ft, 13 Jun 1967, Haskell 2405 (ARIZ). Yuma Co.: Colorado River bottom, Fort Yuma, 100 ft, 15 Apr 1927, Jepson 11732 (ARIZ, UC). Coconino Co.: Havasupai Canyon, 26 Apr 1941, Clover 6410 (ARIZ, LL, US).

NEVADA: Clark Co.: Colorado River, 1 mi S Davis Dam, 800 ft, 8 Apr 1947, Munz 11692 (CAS, DS, RSA, UTC, US, WS, WTU); St. Thomas, 1200 ft, 1 Jun 1938, Train 1909 (DS, F, MO, NDG, UC).

NEW MEXICO: Dona Ana Co.: Organ Mountains, Filmore Canyon, 23 Oct 1904, Wootton s.n. (NMU, US). Grant Co.: Mangas Springs, 18 mi NW Silver City, 4770 ft, 16 Sep 190, Metcalfe 715 (ARIZ, DS, MO, NMC, NY, RM, US). Hidalgo Co.: Peloncillo Mts., Skeleton Canyon, 5000 ft, 6 Sep 1981, Spellenberg 6323 (NMC, NY). Lincoln Co.: White Mountains, 7100 ft, 12 Aug 1897, Wootton 328 (DS, GH, MO, NDG, NMC, NY, POM, RM, UC, US). Otero Co.: 2 3/4 mi NE Mescalero, 8 Sep 1939, Cory 33312 (LL). San Miguel Co.: Las Vegas, Porvenir Creek, 6 Sep 1926, Arsene 17822 (F, US). Sierra Co.: Kingston, 6600 ft, 1 Oct 1904, Metcalfe 1426 (NMC, NY, UC). Socorro Co.: Magdalena Mountains, Water Canyon, 8600 ft, 30 Sep 1973, Hutchins 4885 (NMC).

3b. MACHAERANTHERA ASTEROIDES var. GLANDULOSA B. L. Turner

Phytologia 60:77. 1986. TYPE: ARIZONA. Maricopa Co.: U. S. highway 60, 2.6 mi E of Queen Creek Tunnel, 4200 ft., 19 Sep 1975, Pinkava, Keil & Lehto 118904 (holotype LL; isotypes ASU, CSU, NY).

Machaeranthera hansonii A. Nelson, Univ. Wyoming Publ. Bot. 1: 134. 1926. TYPE: U.S.A. ARIZONA: Mohave Co. (?), "Mount Ellen, near Flagstaff", 7500 ft, without date (in the description given as 16 Aug 1923), H. C. Hanson 814 (holotype RM!). According to Granger's ARIZONA PLACE NAMES (1975), Mt. Ellen is in Mohave Co.

Resembling var. asteroides but differing in its dense vestiture of stalked glandular trichomes (otherwise glabrous), shorter, subulate involucre bracts and generally stiffer, smaller leaves.

DISTRIBUTION (Fig. 2): Mostly central and western Arizona from 100-1000 m, but extending into adjacent New Mexico, Southern Nevada, southwestern Utah and probably Mexico. Flowering: May-Oct.

The variety glandulosa is largely confined to central and southcentral Arizona and is readily distinguished from var.

asteroides by its smaller heads and glandular vestiture. It grades into the var. asteroides east and southwest of Phoenix, as noted under the latter taxon.

In the lower elevations of Washington County, Utah, there occur a puzzling series of populations that superficially resemble M. a. var. glandulosa but such plant possess the involucre of M. canescens and I have annotated most of these as intermediates between M. c. var. canescens and M. c. var. leucanthemifolia (e.g., Christian 1005, ARIZ, POM, TEX, UT, etc.), the two varieties intergrading in this region. The single citation given below for M. asteroides var. glandulosa from Utah is seemingly "typical", being the only unquestionable collection of this taxon which I have seen from the state.

REPRESENTATIVE SPECIMENS: UNITED STATES. ARIZONA: Coconino Co.: Sycamore Canyon Wilderness Area, 11 Oct 1969, Pinkava et al. 58266 (ASU). Gila Co.: Tonto National Forest, Three Bar Game Management, 2 Jul 1958, Pase 947 (ARIZ, ASU, RM). Graham Co.: Pinaleno Mts., Frye Canyon, 15 Sep 1914, Shreve 4356 (ARIZ, US). Greenlee Co.: S of Clifton, 24 Oct 1937, Ramsey 2485 (POM). La Paz Co.: Harquahala Mountain Peak (33° 48' X 113° 23'), 5680 ft, 8 Jun 1983, Daniel & Butterwick 2930 (ASU, NY). Maricopa Co.: Seven Springs, w/o date, Keller s.n. (ASU). Mohave Co.: Chicken Spring Road, 3600 ft, 18 May 1979, Butterwick & Hillyard 4922 (ASU). Pima Co.: Rondstat Ranch, Robles Ranch to Sasabe, 23 Sep 1939, Kearney & Peebles 14529 (ARIZ, NY, US). Pinal Co.: Superstition Mts., southern slopes, 18 Oct 1931, Gillespie 8608 (DS, LL, US). Yavapai Co.: 0.5 mi N Sunset Point, 1 May 1976, Pinkava & Lehto 19931 (ASU, TEX).

NEVADA. Clark Co.: Virgin Mountains, Yant Pit Canyon, 4300 ft, 4 Jun 1941, Munz 16767 (DS, UTC, WS).

NEW MEXICO. Catron Co.: Luna, 28 Jul 1900, Wooton s.n. (US); ca. Glenwood, 13 Aug 1935, Moeller 266 (ARIZ); E Fork of Gila River, 1700 m, 20 Sep 1919, Eggleston 16044 (GH).

UTAH. Washington Co.: Bloomington Price Hills, 1 mi E of I-15, 26 May 1983, Higgins & Welsh 13426 (BYU, NY).

3c. MACHAERANTHERA ASTEROIDES var. LAGUNENSIS (Keck) Turner

Phytologia 60:77. 1986.

Machaeranthera lagunensis Keck, Brittonia 9: 238. 1957. TYPE: U.S.A. CALIFORNIA: San Diego Co., 2 mi S of the main recreation area, Laguna Mountains, 5200 ft, 20 Aug 1952, P. A. Munz & E. K. Balls 17948 (holotype NY!; isotypes RSA!).

Differing from var. asteroides in possessing smaller, broadly turbinate heads with merely acute or short-subulate involucre bracts, fewer ray florets and narrower, mostly entire, leaves.

DISTRIBUTION (Fig. 2): Chaparral and associated desert regions of Baja California from 800-2400 m between latitudes 30°-33° in gravelly or sandy soils; extending into the U.S.A. in San Diego Co. Flowering: Aug-Oct.

The type collection is a small plant with somewhat larger heads and broader involucre bracts than occurs in plants from Mexico. The Mexican populations might be treated as a distinct taxon, but these show considerable variation among themselves and appear to vary in the direction of the var. lagunensis. It should be noted that the latter variety stands somewhat intermediate to M. canescens and M. asteroides, much as M. canescens var. ambigua stands intermediate to M. canescens and M. asteroides. Indeed, lacking geographical data it would be difficult to distinguish var. ambigua from M. asteroides var. lagunensis. An equally good case might have been made for the inclusion of var. lagunensis under the broad rubric of the more northern M. canescens. If so, all of M. asteroides would tumbel into this fabric, as would M. bigelovii, since the typical elements of each, to some degree, intergrade at their peripheries.

REPRESENTATIVE SPECIMENS: MEXICO. Baja California: 1.3 mi NW Rancho Las Filipinas, 1650 m, 17 Sep 1966, Moran 13574 (ARIZ, LL, NY, RSA, UC); 5 mi NW La Grulla, Sierra San Pedro Martir, 6700 ft, Wiggins & Demaree 4862 (LL, NY, POM, UC).

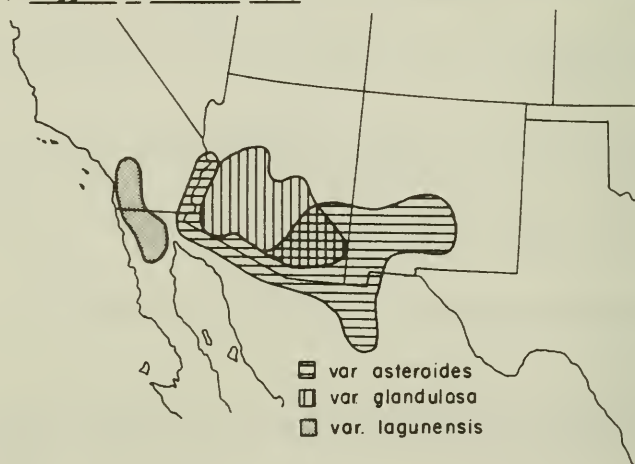


Fig 2b. Approximate distribution of varieties of M. asteroides.

Key to varieties of M. bigelovii

1. Involucres broadly turbinate to hemispheric 1/2-2(4) times as broad as high; involucral bracts 30-100, mostly 1-2 mm wide at mid-point, their appendages shortly acute to subulate; N Mex., Col; S Wyo and S Utah
2. Involucral bracts mostly 25-40, ray florets mostly 21-35; plants of southcentral Utah 4b. var. commixta
2. Involucral bracts mostly 50-100, ray florets mostly 40-57; plants of S Wyo, Colo and N. Mex 4a. var. bigelovii
1. Involucres hemispheric, 2-4 times as broad as high; involucral bracts 90-100, mostly 0.5-1.0 mm wide at mid-point, their apices linear-subulate; Northcentral Arizona ... 4c. var. mucronata

4a. MACHAERANTHERA BIGELOVII (A. Gray) Greene var. BIGELOVII

Aster bigelovii A. Gray, Pacific Railroad Report 4: 97. 1856.
Machaeranthera bigelovii (A. Gray) Greene, Pittonia 3: 63. 1896.
 TYPE: U.S.A. NEW MEXICO. Bernalillo Co., "Arroyos in the Sandia Mts", 10 Oct 1853, Dr. J. M. Bigelow s.n. (holotype GH!; isotypes NY!).

Machaeranthera canescens var. alpina T. C. Porter, U.S. Dept. Int. Misc. Rept. 4: 59. 1874. TYPE: U.S.A. COLORADO: Clear Creek Co. (?), "Alpine regions of Rocky Mountains", 1872, C. C. Parry s.n. (holotype PHIL!; probable isotypes F!, GH!, NEB!, NY!). According to Ewan (1981), Parry collected in the region of Clear Creek Co. in this year.

Aster pattersonii A. Gray, Proc. Amer. Acad. Arts 13: 372. 1878. Machaeranthera pattersonii (A. Gray) Greene, Pittonia 3: 63. 1896. TYPE: U.S.A. COLORADO: Clear Creek Co., Gray's Peak, "upper edge of wood-line", 2-5 Aug 1877, J. D. Hooker & A. Gray s.n. (lectotype, designated by Almut Jones upon annotation, GH!). Ewan (1981) gives a brief account of the collectors activity in this region.

Machaeranthera pattersonii var. hallii A. Gray, Proc. Amer. Acad. Arts 13: 372. 1878. TYPE: U.S.A. COLORADO. "Rocky Mts", 1862, E. H. Hall & J. P. Harbour 285 (lectotype GH!; isolectotype F!).

Aster townshendii Hook., Curtis Bot. Mag. 105: t.6430. 1879. TYPE: U.S.A. COLORADO. Raised at KEW from seeds collected by R.

B. Townshend in southern Colorado in 1877 (holotype KEW; isotypes GH!).

Machaeranthera aspera Greene, Pittonia 3: 62. 1896. TYPE: U.S.A. COLORADO. Jefferson Co., Berger Park, 20 Aug 1877, E. L. Greene s.n. (holotype NDG!).

Machaeranthera varians Greene, Pittonia 4: 98. 1899. TYPE: U.S.A. COLORADO: Mineral Co., near Pagosa Peak, 8000 ft, 30 Aug 1899, C. F. Baker 695 (lectotype, as selected by the annotation of L. H. Shinnars, NDG!; isolectotypes F!, GH!, NDG!, NY!, POM!, RM!, UNM!, US!).

Machaeranthera rubricaulis Rydb., Bull. Torrey Bot. Club 28: 506. 1901. TYPE: U.S.A. COLORADO. Las Animas Co., La Veta, on Mesas, 7000 ft, 26 Sep 1900, F. K. Vreeland 681 (holotype NY!; isotypes NY!, RM!).

Machaeranthera spectabilis Greene, Leaflet Bot. Observ. Crit. 1: 148. 1905. TYPE: U.S.A. COLORADO: Saguache Co., Clayey banks at Marshall Pass, 10,000 ft., 20 Aug 1901, C. F. Baker 873 (holotype NDG!, isotypes GH!, NY!, POM!, RM!, UC!, US!).

Machaeranthera viscosula Rydb., Bull. Torrey Bot. Club 32: 124. 1905. TYPE: U.S.A. COLORADO. Costilla or Huerfano Co., Veta Pass, 15 Jul 1896, C. L. Shear 3655 (holotype NY!).

Machaeranthera aquifolia Greene ex Woot. & Standl., Contr. U.S. Natl. Herb. 16: 188. 1913. Aster aquifolius (Greene) Blake, J. Wash. Acad. Sci. 30: 47. 1940. TYPE: U.S.A. NEW MEXICO. Socorro Co.: Gila Hot Springs in the Mogollon Mountains, ca 6500 ft, 26 Aug 1903, O. B. Metcalfe 856 (holotype US!; isotypes NDG!, NMC!, NY!, RM!).

Machaeranthera centaureoides Greene ex Woot. & Standl., Contr. U. S. Natl. Herb. 16: 188. 1913. TYPE: U.S.A. NEW MEXICO: Socorro Co., "Mogollon Mountains on the Middle Fork of the Rio Gila", ca 2250 m, 9 Aug 1903, O. B. Metcalfe 440 (holotype US!; isotypes NMC!, NY!, RM!).

Erect biennial or short-lived perennial, usually glandular, herbs 10-100 cm high. Leaves simple, lanceolate to oblanceolate, mostly 0.8-2.5 cm wide, 4-20 cm long, variously puberulent to nearly glabrous, the margins denticulate to nearly entire, gradually tapering (lower leaves) to clasping (upper leaves). Heads hemispheric, large and relatively few (1-30); involucre bracts glandular pubescent, 5-10 seriate, subimbricate, numerous with mostly tapering reflexed, elongate-subulate, glandular apices. Receptacle convex, alveolate, 4-8 mm across. Ray florets mostly 34-150, pistillate, fertile; ligules purple to bright lavender-blue, 1.0-2.5 cm long, 1-2 mm wide. Disk florets numerous; corollas yellow, tubular, 5-7 mm long, the limb glabrous, the lobes

ca 0.5 mm long, minutely pubescent. Achenes obovate to somewhat subfalcate, 3-5 mm long, sparsely appressed sericeous; pappus of 40-50 white or tawny, persistent, ciliate bristles, mostly 5-6 mm long.

Chromosome number, $2n=8$.

DISTRIBUTION (Fig. 2): Southern-most Wyoming to southcentral New Mexico mostly in open areas of spruce-fir subalpine forests from 2500-3500 m but extending into lower regions along streams, etc. Flowering: Jul-Oct.

Collections from Park County Colorado and surrounding areas presumably show past inflow of genes from *M. canescens*. Such plants are typically intermediate in habit between these taxa, possessing smaller heads with fewer ray florets (21-55). Indeed, collections of *M. bigelovii* from San Miguel Co. (Weber 3596) show strongly the influx of genes from *M. canescens*, and vice versa (e.g., Ownbey 1485 DS, GH, MONT, RM, UTC, which has the general habit of *M. bigelovii*, but in most other characters is typical *M. canescens*). Specimens more or less intermediate to *M. bigelovii* and *M. canescens* have been called *M. spectabilis* while those strongly tending toward *M. canescens* have been called *M. rubricaulis*.

In the White Mountains of Lincoln County New Mexico, and probably also in the Mogollon Mountains, where *M. bigelovii* comes into contact with *M. asteroides*, local populations show evidence of introgression from one into the other. Thus both *M. centaureoides* and *M. aquifolia* from Socorro Co., New Mexico, have the general habit of *M. asteroides* but possess the glandular peduncles and involucre bracts of *M. bigelovii*. Indeed, in these areas taxonomic designation becomes somewhat arbitrary, those individuals with more glandular peduncles and involucre bracts becoming *M. bigelovii*. In general, the latter occurs in more mesic, higher elevational sites than does *M. asteroides*.

Machaeranthera bigelovii occasionally shows variation towards *M. canescens* var. *glabra*, at least to judge from "*bigelovii*-type" involucres on what otherwise appear to be *M. c.* var. *glabra* (e.g. sheets from the Raton Pass area in Mesa Co. Colorado, Standley 14418, etc.).

Finally, it should be noted that the Nevada dot shown in Fig. 2 is based upon two collections, both from Glenbrook along Lake Tahoe (20 Jul 1931, L. S. Rose s.n., CAS; 6 Jul 1919, I. Tidestrom 10328, LL, US). The collections are unquestionably good *M. bigelovii* but are perhaps introduced into the region. I visited this site in July of 1986 and was unable to locate any such plants in this region. The village, including the old highway, is now part of a large highly restricted, private housing complex. In any case, I suspect the population concerned were "garden escapes".

REPRESENTATIVE SPECIMENS: UNITED STATES. COLORADO: Alamosa Co.: Open rocky flat, Sand Dunes Natl. Monument, 8000 ft, 7 Sep 1947, Harrington 3791 (CSU) - more or less intermediate with var. canescens. Archuleta Co.: 21 mi SE Pagosa Springs, 25 Aug 1952, Waterfall 11091 (UTC). Boulder Co.: Lake Eldora, 1 Aug 1918, Clokey 3166 (CAS, DS, GH, RM, TEX, US). Chaffee Co.: lower edge of Arkansas River at Salida, 22 Aug 1938, Ewan 11545; Buena Vista 21 Aug 1919, Clokey 3444 (CAS, DS, F, GH, MONT, NY, RM, UC, US, WS) - the latter collections are more or less intermediate to M. canescens. Clear Creek Co.: Empire, 2750 m, 11 Aug 1920, Clokey 3914 (CAS, DS, F, GH, LL, MONT, NY, POM, RM, US, WS). Costilla Co.: Chama, 4 Sep 1899, Baker 694 (GH, NY, RM). Custer Co.: Sangre de Cristo Range, Middle Taylor Creek, 10,000 ft, 5 Sep 1943, Ewan 15401 (RSA). Dolores Co.: vicinity of Rico, 13 Sep 1935, Maguire & Paranian 12926 (UTC). Douglas Co.: 5 mi N. Deckers, 6700 ft, 22-27 Aug 1966, Freeman & Lehto 29 (ASU). Eagle Co.: Tennessee Pass, 10,000 ft, 16 Aug 1919, Clokey 3476 (CAS, F, GH, MONT, NY, RM, US). El Paso Co.: above Manitou, 25 Aug 1915, Osterhout 5409 (POM, RM). Fremont Co.: Ore Creek, 28 Jul 1873, Brandegge 521 (DS). Gilpin Co.: 3 mi N of Golden Gate State Park, 20 Aug 1970, Watson 504 (MONTU, TEX). Grand Co.: Berthoud Pass, Jul 1903, Tweedy 5832 (NY, RM). Gunnison Co.: Rogers, 14 Aug 1901, Baker 803 (GH, NDG, NY, POM, RM, US, WS). Hinsdale Co.: 6 mi NW of Rio Grande Reservoir, 10,500 ft, 8 Aug 1936, Rollins 1505 (GH, NY). Huerfano Co.: Cuchara, Bear lake Camp, 25 Aug 1968, Demaree & Weber 59110 (UT). Jefferson Co.: foothills near Golden, 20 Jun 1878, Jones 274 (NY, POM, UTC). Lake Co.: Everett, 4 Aug 1919, Clokey 3507 (CAS, DS, F, GH, MONT, NY, POM, RM, UTC, US, WS). La Plata Co.: 20 mi N Durango, 26 Jul 1967, Porter 10474 (DS, GH, NY, RM, UC, US). Larimer Co.: ridge tops, Big Thompson Canyon, 3 Sep 1940, Nelson 4583 (DS, GH, RM, UC, US). Las Animas Co.: S of Morley, 7800 ft, 28 Aug 1934, Goodman 2302 (MO). Mineral Co.: 5 mi below Summit of Wolf Creek Pass, W side, 28 Jul 1928, Wolf 3073 (CAS, DS, GH, POM, UC). Montezuma Co.: Montezuma Natl. Forest, 8900 ft, 27 Aug 1922, Cayton 7 (RM). Montrose Co.: Montrose, 22 Jul 1897, Shear 4896 (RM, US). Park Co.: 13 mi W Florissant, 12 Aug 1983, Gieschen 104 (TEX). Saguache Co.: Rock Creek, Rio Grande Natl. Forest, 30 Aug 1939, Gierisch 1176 (GH). San Juan Co.: 21 mi S of Silverton, 14 Aug 1954, Waterfall 11709 (RSA, TEX). San Miguel Co.: 1 mi N of Ophir, 10 Sep 1947, Weber 3596 (CAS, DS, GH, RSA, UC, TEX, US, WS, WSU). Summit Co.: 5 mi E Tiger, 27 Jul 1972, Nelson 922 (CSU). Teller Co.: dry cuts, "Divide-Cripple Creek", 2 Aug 1920, Clokey 3913 (CAS, DS, F, GH, LL, MONT, NY, PHIL, POM, RM, UC, US, WS).

NEW MEXICO: Bernalillo Co.: Sandia Mountains, Balsam Park, 8200 ft, 10 Aug 1914, Ellis 220 (MO, NY, US). Catron Co.: Mogollon Mts., West Fork of Gila River, 8500 ft, 14 Aug 1903, Metcalfe 504 (ARIZ, GH, NMC, NY, RM, US). Colfax Co.: 4.3 mi W Yankee, 8 Aug 1970, Weber & Arp 14178 (CAS, BYU, NY). Grant Co.: Mogollon Mts., moist grassy summits, Sep 1881, Rusby 145 1/2 (GH, MO, NY, PHIL, US). Lincoln Co.: White Mts., E facing slopes, 9680

ft, 21 Aug 1968, Hutchins 1565 (NMC). Los Alamos Co.: Bandelier Natl. Monument, Frijoles Canyon, 9000 ft, 26 Sep 1982, Dunbar 321 (NMC). Mora Co.: highway 3, 5 mi SE Taos Co. line, 17 Aug 1982, Sundberg 1652 (TEX). Otero Co.: 9 mi S Cloudcraft, 9 Sep 1973, Spellenberg 3681 (ARIZ, NMC, NY). Rio Arriba Co.: Chama 4 Sep 1899, Baker (NDG, NMC, POM). Sandoval Co.: Jemez Springs, 23 Aug 1931, Nelson 11629 (DS, MO, PHIL, RM). San Miguel Co.: near Pecos Baldy Lake, 11,500 ft, 10 Sep 1959, Saunders s.n. (CAS). Sierra Co.: Sawyer's Peak, 9400 ft, 30 Sep 1904, Metcalf 1438 (NMC). Taos Co.: Santa Barbara Canyon, 8000 ft, 6 Sep 1965, Niles 654 (ARIZ, TEX, UNLV). Valencia Co.: Milo Canyon, San Mateo Mts., 8900 ft, 27 Aug 1979, Moir & Fitzhugh 747 (NMC).

WYOMING: Albany Co.: Dry granite gravels, Colorado - Wyoming state line, 9 Sep 1928, Nelson 10957 (DS, RM).

- 4b. MACHAERANTHERA BIGELOVII var. COMMIXTA (Greene) B. L. Turner
Phytologia 60:77. 1986.

Machaeranthera commixta Greene, Pittonia 4: 71. 1899. M. canescens var. commixta (Greene) Welsh, Great Basin Naturalist 43: 316. 1983. TYPE: U.S.A. UTAH: Garfield Co., Henry Mountains, Bromide Pass, 10,000 ft, 27 Jul 1894, M. E. Jones 5695y (holotype US!; isotype POM!).

Differing from the var. bigelovii in its smaller heads with fewer ray florets and broader involuclral bracts. Populations mostly occur in open areas of spruce-fir forests from 2800-3200 m. They appear to occasionally intergrade downslope with M. canescens, much as the var. bigelovii does in Colorado.

DISTRIBUTION (Fig. 2): UNITED STATES. Open areas of subalpine spruce-fir forests from 2800-3200 m in southern Utah. Flowering: Jul-Sep.

It should be noted that were these "disjunct" populations of M. bigelovii not already named, and to some extent in use, a varietal epithet would hardly seem appropriate for such weakly differentiated variants. Actually, I suspect that the glandular trichomes of involuclral bracts and peduncles (characters which mark M. bigelovii) are independently derived in Utah, thus a less conservative treatment might place the var. commixta as closer to M. canescens. But it is also possible that the high elevational populations so marked are the result of "residual" gene flow or "swamping" from M. canescens into M. bigelovii in this region.

REPRESENTATIVE SPECIMENS. UNITED STATES. UTAH: Garfield Co.: Henry Mountains, Mt. Ellen, 9000 ft, 17 Aug 1980, Neese & Neese 9638 (BYU); 1 mi S Wickiup Pass, 9200 ft, 25 Aug 1977, Neese & White 4115 (BYU, DAV, NY). Iron Co.: 3 mi N Cedar Breaks Lodge,

10,300 ft, 12 Aug 1938, Hitchcock et al. 4604 (RM, UC, UTC). Kane Co.: west lodge, Navajo Lake, 14 Jul 1940, Maguire (BYU, NY, UC, UTC, WSU). Washington Co.: Kobb, near reservoir, 3070 m, 5 Aug 1983, Higgins 14123 (BYU, NY).

4c. MACHAERANTHERA BIGELOVII var. MUCRONATA (Greene) B. L. Turner, comb. nov.

Machaeranthera mucronata Greene, Pittonia 4: 72. 1899. Aster adenolepis Blake, J. Wash. Acad. Sci. 30: 471. 1940. Non A. mucronatus Sheldon, 1903. TYPE: U.S.A. ARIZONA: Coconino Co., Thompson Canyon, 8500 ft, 19 Sep 1894, M. E. Jones 6065b1 (lectotype, selected here, US!).

Differing from the var. bigelovii in possessing more numerous slender involucral bracts with longer apical appendages and having peduncles which are inconspicuously glandular, if at all.

DISTRIBUTION (Fig.): Known only from the spruce-fir forests of the Kaibab Plateau in northcentral Arizona from 2800-3000 m. Flowering: Aug-Sep.

This taxon might sit as comfortably within M. asteroides as it does within M. bigelovii. I have included this within the latter because of its geographical location and proclivity for spruce-fir forests at elevations similar to those of M. bigelovii in Colorado. Certainly it is not as closely related to the var. bigelovii as is the var. commixta. Perhaps the var. mucronata has been derived from past hybridization between M. asteroides and M. bigelovii. Alternatively the var. mucronata might be a recently derived subalpine ecotype of the parapatric, lower elevational, M. canescens var. ambigua, in which case a better phylogenetic arrangement would call for the inclusion of both var. ambigua and var. mucronata under M. asteroides.

REPRESENTATIVE SPECIMENS. UNITED STATES: ARIZONA. Coconino Co.: Kaibab Forest, De Motte Park, 8700 ft, 26 Jul 1977, Gierisch 3969 (ASU, BYU); 15 mi S Jacob Lake, 8500 ft, 16 Aug 1946, Parker et al. 6210 (ARIZ, CAS, DS, F, LL, NY, UTC).

5. MACHAERANTHERA CANESCENS

5A. Machaeranthera canescens subsp. canescens

5a. var. canescens

5b. var. incana

5c. var. sessiliflora

5d. var. shastensis

5e. var. leucanthemifolia

5f. var. ziegleri

5g. var. ambigua

5B. *Machaeranthera canescens* subsp. glabra (A. Gray) Turner,
comb. nov. - M. c. var. glabra Pl. Wright. 1: 89. 1850.

5h. var. glabra

5i. var. nebraskana

5j. var. aristata

Key to varieties of M. canescens

1. Involucral bracts manifestly reflexed, variously glandular or rarely both glandular and canescent (except in var. ambigua with appressed pubescent bracts); NW Nebraska, Dakotas, Montana, and Canada Southward to N. New Mexico and Arizona and Westward to Washington then southward along the eastern Sierras to Baja California, Mexico 5a. subsp. canescens
2. Heads (12)14-20 mm high, 15-20 mm wide (pressed); suffruticose perennials with persistent woody crowns; Santa Rosa Mountains of southern Calif 5f. var. ziegleri
2. Heads mostly 6-12(14) mm high, 10-15 mm wide (pressed); annuals, biennials or short lived perennials; widespread.
3. Stem's canescent or puberulent throughout, without glandular trichomes or with a mixed canescent-glandular vestiture (except in peripheral or altitudinal intergrades)
4. Stems stiffly erect to 60 cm high divaricately branched with usually numerous heads; ray florets pistillate and fertile; sandy soils mostly along streams of Washington, Oregon, N California and adjacent Idaho and Canada. 5b. var. incana
4. Stems various but usually smaller, with a relaxed branching and generally few to a moderate number of heads; ray florets absent, neuter, or pistillate and fertile; more

montane habitats to the south and west.

5. Heads without ray florets or these variously reduced or neuter (w/o styles); involucre mostly 6-10 mm high, often 3-5(7) seriate; N Calif. and Oregon and adjacent Nevada 5d. var. shastensis
5. Heads with well-developed ray florets, these variously pistillate and fertile; involucre mostly (6)8-12(14) mm high, usually 5-10 seriate.
6. Involucral bracts with appressed, pubescent, apices; leaves mostly linear to lanceolate; achenes glabrous or nearly so; pine forests of N Arizona and adjacent New Mexico 5g. var. ambigua
6. Involucral bracts variously glandular and to some extent reflexed; leaves usually obovate to spatulate; achenes pubescent; wide-spread at various elevations in montane habitats from Canada to S Calif 5a. var. canescens
3. Stems prominently beset with glandular trichomes, otherwise glabrous or variously intermixed with a canescent vestiture.
7. Involucral bracts mostly acute, not usually sharply reflexed; stems both canescent and atomiferous-glandular; heads usually turbinate and

nearly sessile; sands along the Snake River in Idaho. 5c. var. sessiliflora

7. Involucral bracts mostly obtuse, sharply reflexed; stems with well-developed glandular trichomes; heads usually campanulate and pedunculate; intermontane desert regions of SE Ore., Nev., and adjacent regions of Utah and Calif 5e. var. leucanthemifolia

1. Involucral bracts mostly appressed, variously pubescent, only rarely glandular or glabrous but if so nearly always appressed, fore-plains and lower elevations of the Rocky Mountains from S Montana to N Mexico, westward into New Mexico to Arizona and adjacent Utah 5B. subsp. glabra

8. Involucral bracts densely appressed puberulent, any glands obscured by the pubescence; involucre 10-20 mm high.

9. Involucral bracts canescent, usually recurved; sand hills of Nebraska and adjacent areas ... 5i. var. nebraskana

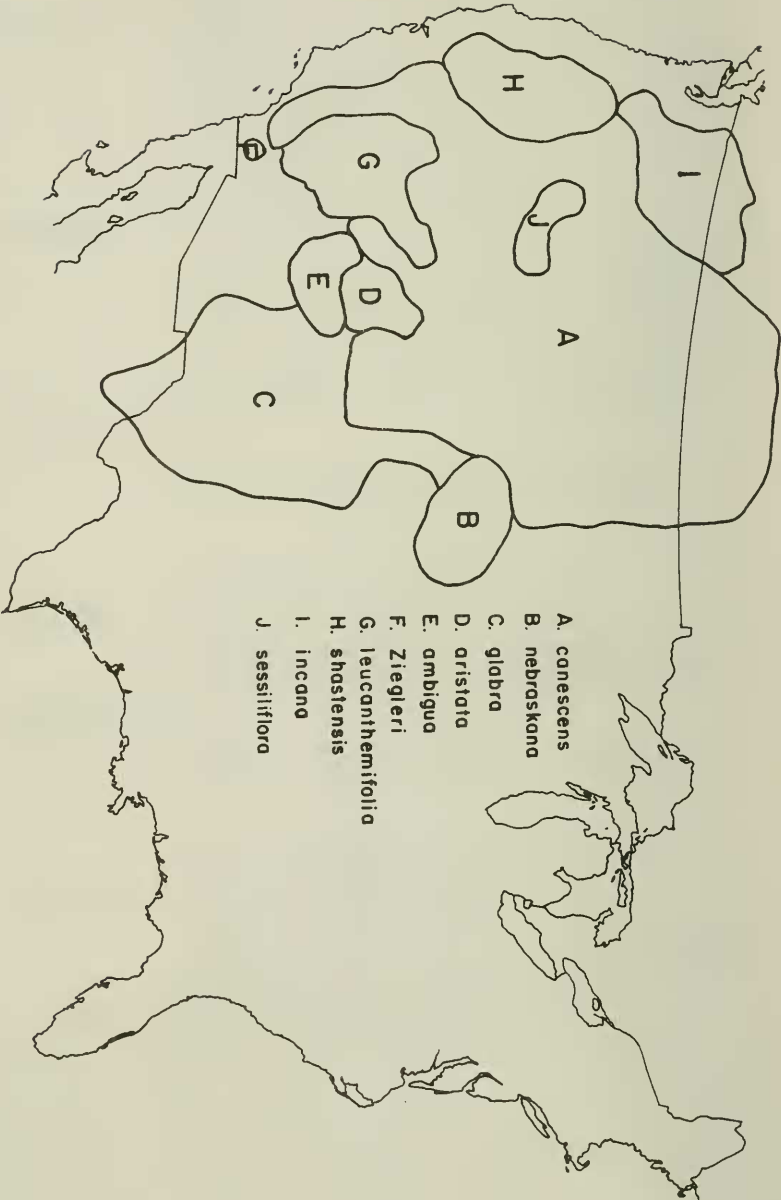
9. Involucral bracts appressed pubescent, usually appressed; pine forests of N Ariz., N New Mex and adjacent Colo 5g. var. ambigua
(subsp. canescens)

8. Involucral bracts glandular or nearly glabrous; involucre mostly 8-10 mm high.

10. Mid-stems with prominent glandular trichomes (rarely glabrous); SE Utah, adj Ariz, N Mex and Colo. 5j. var. aristata

10. Mid-stems glabrous to canescent; fore plains of the Rocky Mts. from S Mont. to Tex into northern Mexico then eastward to E Ariz and SE Utah and adjacent Colo 5h. var. glabra

Fig. 3. Approximate distribution of varieties of Machaeranthera canescens.



5a. MACHAERANTHERA CANESCENS (Pursh) A. Gray var. CANESCENS

Aster canescens Pursh, Fl. Am. Sept. 547, 1814. Dieteria canescens (Pursh) Nutt., Trans. Amer. Phil. Soc. II. 7: 300. 1840. Machaeranthera canescens (Pursh) A. Gray, Pl. Wright. 1: 89. 1850. TYPE. U.S.A. N. Dakota: "On the denuded banks of the Missouri". (in the vicinity of Fort Mandon), 1811. Nuttall s.n. (holotype BM; possible isotypes NDG!).

Dieteria viscosa Nutt., Trans. Amer. Phil. Soc., N. Ser., 7: 301. 1840. Aster canescens var. viscosus (Nutt.) A. Gray, Syn. Fl. 12: 206. 1884. Machaeranthera viscosa (Nutt.) Greene, Pittonia 4: 22. 1899. Machaeranthera canescens var. viscosa (Nutt.) Piper, Contr. U.S. Natl. Herb. 11: 576. 1906. TYPE: U.S.A. NEBRASKA: Scotts Bluff Co., "near Scott's Bluff, on the Platte", 1834, Nuttall s.n. (lectotype BM).

Dieteria divaricata Nutt., Trans. Amer. Phil. Soc., n. ser., 7: 300. 1840. Machaeranthera divaricata (Nutt.) Greene, Pittonia 4: 23. 1899. TYPE: U.S.A. "Denudated plains of the Rocky Mountains, and Oregon, common". 1834., Nuttall s.n. (lectotype BM; isolectotypes NDG!, GH!). The specimen at GH bears the locality "Borders of the Platte", presumably in Nuttall's script.

Dieteria pulverulenta Nutt., Trans. Amer. Phil. Soc., N. Ser. 7: 300. 1840. Machaeranthera pulverulenta (Nutt.) Greene, Pittonia 4: 23. 1899. TYPE: U.S.A. "Arid plains toward the sources of the Platte", 1834, Nuttall s.n. (lectotype BM; isolectotype GH!).

Machaeranthera laetevirens Greene, Pittonia 3: 61. 1896. Aster leiodes Blake, Contr. U.S. Natl. Herb. 25: 563. 1925., not A. laetevirens Greene (1900). TYPE: U.S.A. NEVADA: Lincoln Co., Clover Mountains, 26 Jul 1894, E. L. Greene s.n. (holotype NDG!; isotype NDG!).

Machaeranthera montana Greene, Pittonia 3: 60. 1896. Machaeranthera shastensis var. montana (Greene) Cronq. & Keck, Brittonia 9: 238. 1957. TYPE: U.S.A. CALIFORNIA: Mono Co., near Mono Lake, Sep 1866, Bolander 6147 (lectotype, selected by L. H. Shinnars, NDG!; isolectotypes F!, GH!, MO!, UC!, US!).

Machaeranthera subalpina Greene, Pittonia 4: 23. 1899. TYPE: U.S.A. WYOMING: Teton Co., Bacon Creek, 15 Aug 1894, A. Nelson 904 (holotype NDG!; isotypes GH!, NDG!, PHIL!, RM!).

Machaeranthera spinulosa Greene, Pittonia 4: 24. 1899. TYPE: U.S.A. OREGON: Baker Co., dry hillsides, 3500 ft, Powder River Mountains, Aug 1897, W. C. Cusick 1811 (holotype NDG!; isotypes DS!, MO!, NDG!, UC!, US!, WS!).

Machaeranthera linearis Rydb., Mem. N.Y. Bot. Gard. 1: 398. 1900 - non M. linearis Greene. Machaeranthera angustifolia Rydb., Bull. Torrey Bot. Club 37: 147. 1910. not M. angustifolia Woot. & Standl. TYPE: U.S.A. WYOMING: Yellowstone Park, 8500 ft, 6 Aug 1885, G. W. Letterman s.n. (holotype NY!).

Machaeranthera superba A. Nels., Bot. Gaz. 30: 197. 1900. TYPE: U.S.A. WYOMING: Yellowstone Natl. Park, Yellowstone Lake, 6 Aug 1900, A. & E. Nelson 6337 (holotype RM!; isotypes GH!, NDG!, NY!, POM!, RM!, US!).

Machaeranthera ramosa A. Nels., Bull. Torrey Bot. Cl. 28: 233. 1901. TYPE: U.S.A. WYOMING: Albany Co., Laramie, 27 Aug 1900, A. Nelson 8152 (holotype RM!; isotypes GH!, LL!, NEB!, NY!, RM!, US!, UTC!).

Aster glossophyllus Piper, Bull. Torrey Bot. Cl. 29: 646. 1902. A. shastensis var. glossophyllus (Piper) Cronq., in Hitchc., Cronq. et al., Vascular Pl. Pacific N.W. 5: 94. 1955. Machaeranthera shastensis var. glossophylla (Piper) Cronq. & Keck, Brittonia 9: 238. 1957. TYPE: U.S.A. OREGON: Malheur Co., "Black Butte", 19 Jul 1901, W. C. Cusick 2680a (holotype US!).

Machaeranthera glabella Greene ex Rydb., Colorado Agric. Exptl. Sta. Bull. 100: 358. 1906. TYPE: U.S.A. COLORADO: Gunnison Co.: Cerro Summit, 8000 ft, 1 Aug 1901, C.F. Baker 701 (lectotype NY!; isolectotypes NDG!, POM!, RM!, UC!, US!).

Machaeranthera selbyi Rydb., Bull. Torrey Bot. Cl. 32: 123. 1905. TYPE: U.S.A. COLORADO: Ouray Co., SE of Ouray, chaparral covered hills, 2300-2600 m, 7 Sep 1901, L.M. Underwood & A. D. Selby 93a (holotype NY!).

Machaeranthera latifolia A. Nels., Proc. Biol. Soc. Wash. 20: 38. 1907. TYPE: U.S.A. UTAH: Salt Lake Co., Big Cottonwood Canyon, 8950 ft., 9 Aug 1933, A. O. Garrett 1933 (holotype RM!; isotypes GH!, LL!, US!).

Machaeranthera paniculata A. Nels., Proc. Biol. Soc. Wash. 20: 38. 1907. TYPE: U.S.A. UTAH: Salt Lake Co.: "Mountains of Parley's Park", 6500 ft, 13 Sep 1906, A. O. Garrett 2083 (holotype RM!; isotypes LL!, US!).

Machaeranthera leptophylla Rydb., Bull. Torrey Bot. Cl. 37: 147. 1910. TYPE: U.S.A. UTAH: Cache Co., Logan, 9 Aug 1895, P. A. Rydberg s.n. (holotype NY!).

Aster shastensis var. latifolius Cronq., in Hitchc., Cronq. et al., Vascular Pl. Pacific N.W. 5: 94. 1955. Machaeranthera shastensis var. latifolia (Cronq.) Cronq. & Keck, Brittonia 9: 238. 1957. TYPE: U.S.A. OREGON: Wallowa Co., source of Middle Fork of the Imnaha River, Wallowa Mountains, "Alpine, loose, sliding

soil", 12 Aug 1911, W. C. Cusick 3701 (holotype WS!; isotypes NY!, UC!, WTU!).

DISTRIBUTION (Fig. 3): Along the front-range of the Rocky Mountains from Canada to Colorado and montane regions of Wyoming, northern Colorado and adjacent Utah and Idaho where it is fairly uniform, but westward and southward in the montane regions of Utah, Nevada Arizona, and adjacent California it grades into the allopatric variatal taxa which surround it. Flowering: Jul-Nov.

In central Colorado and southern Utah var. canescens is sympatric with M. bigelovii. The latter grows in more alpine habitats but downslope it intergrades upon occasion into the var. canescens, presumably through the formation of localized hybrid populations from which introgression in both directions, either past or present, might be inferred. Indeed, some of these putative introgressed populations appear to be fairly uniform in south-central Colorado (low plants which branch from the base and possess smaller heads with generally fewer ray florets), and these have been called M. spectabilis, which I have placed in synonymy with M. bigelovii since they possess the technical characters of the latter.

In Washington Co. Utah a broad range of intermediates of var. canescens with adjacent, mosly allopatric, varieties of aristata, leucanthemifolia and ambigua may be found, as noted in the specimens cited for this county (below).

A bewildering array of intermediates between the var. canescens and var. leucanthemifolia may also be found in northern Inyo and adjacent Mono counties California. To cite but a few: Inyo Co., Marble Canyon Spring, White Mountains, 8450 ft, 6 Aug 1930, Duran M34 (NY, UC, UTC); 9.1 mi N of Westgard Pass, 10,4000 ft, 15 Sep 1959, Twisselmann 5810 (CAS, UC); Mono Co., Sherwin Hill, 3 Sep 1942, Alexander & Kellogg (LL, MO, NY, UC, UTC). Most of these are found at high elevations and probably are the result of gene flow from the allopatric but lower-elevation populations of var. leucanthemifolia. The large-headed, stiffly divaricate, individuals of var. canescens which occur at high elevations above the western edge of Inyo County and into Kern and Los Angeles Counties are probably fairly stabalized populations showing past gene-flow from var. leucanthemifolia. Even the smaller-headed, dwarf, alpine forms of var. canescens in these regions show a branching habit and glandularity which is suggestive of such gene-flow.

Likewise in eastern San Bernardino County there is a variable group of intermediates between var. canescens and var. leucanthemifolia, especially on and about the New York Mts. (e.g., Henrickson 10336, DS; 10412 LL, RSA; 11192, RSA; 12588, RSA; 12652 DS, LL; Thorne et al. 47937, ARIZ, RSA; etc.). These are mostly at higher elevations on dry rocky slopes; relatively "pure"

leucanthemifolia occurs in the same vicinity but at lower elevations on dune sands. No doubt there has been considerable gene flow between the two varieties in this region, much as about Mono Lake.

Finally it should be noted that the isolated populations of var. canescens in Ventura Co., California, partake of characters (ray florets much-reduced or absent) that suggest the more northern var. shastensis. Indeed, were these found along the periphery or within the distribution of the latter I would surely have annotated these as such. However, since the plants concerned are similar to those of San Bernardino County (habitally and by the mixed canescent-glandular vestiture) it would seem more reasonable to accept these as phyletically closer to the var. canescens.

REPRESENTATIVE SPECIMENS. CANADA. ALBERTA: vicinity of Rosedale, 14 Aug 1915, Moodie 1206 (DS, F, GH, NY, US). BRITISH COLOMBIA: E of Osoyoos, 3 mi up Richter Pass road, 30 Aug 1937, McCabe 4578 (UC). SASKATCHEWAN: Maple Creek, 14 Jul 1947, Breitung 4872 (MO, NEB).

UNITED STATES. ARIZONA: Coconino Co.: Road above House Rock Canyon, 7 Jun 1936, Peebles 13025 (ARIZ, LL) - this, and most collections from Coconino Co. are intergrades into the var. leucanthemifolia. Mohave Co.: West base of Vulcan's Throne, Toroweap, 6 Sep 1953, Cottam 13866 (UT) - This and a few other collections from Mohave Co. intergrade into var. leucanthemifolia.

CALIFORNIA: Alpine Co.: just E of Luther Pass, highway 89, 20 Jul 1983, Gieschen 65 (TEX). Amador Co.: 2 mi S Carson Spur, 25 Jul 1940, Weier s.n. (DAV). Eldorado Co.: Richardson's Landing, near Tallic, 15 Aug 1927, Blake 10288 (GH, TEX, UC). Fresno Co.: Kings Canyon Natl. Park, upper Paradise Valley, 3 Sep 1941, Alexander & Kellogg 2639 (DS, LL, UC, WS, WTU). Inyo Co.: N fork of Titus Canyon, 23 Jun 1935, Gilman 1836 (LL) - small-headed more typical form; Olancha Pass to Sage Flat, 6500-8000 ft, 26 Jul 1940, Howell 27738 (CAS, US) - large-headed, stiffly erect forms. Kern Co.: Harris Grade, 5.8 mi E Landers Meadow, 16 Sep 1964; Twisselmann 10204 (CAS, UC). Lassen Co.: Doyle, arid plains, 30 Sep 1923, Applegate 4031 (DS, UC). Los Angeles Co.: San Gabriel Mts., Mescal Creek, 30 Aug 1923, Peirson 4008 (RSA, UC). Madera Co.: Minaret Summit, 9200 ft, 15 Jul 1951, Raven 3488 (CAS). Mono Co.: Leevining Grade, 7300 ft, 29 Sep 1937, Rose 37704 (CAS, MO, NY, UC). Nevada Co.: near Donner Lake, 1865, Torrey 222 (US). San Bernadino Co.: N base of Sugarloaf Mt., 7600 ft, 22 Jul 1926, Munz 10783 (GH, LL, POM, UC, US). Tulare Co.: Kern Plateau, Ridge between Troy Meadow and Beach Meadow, 21 Aug 1964, Twisselmann 9975 (RSA, UC). Tuolumne Co.: 8 mi E of Sonora Pass, 28 Jul 1961, Bacigalupi et al. 8010 (UC). Ventura Co.: Mt. Pinos, end of Iris Point Spur road, 13 Jul 1966, Twisselmann 12606 (CAS, OSC, RSA, UC).

COLORADO: Chaffee Co.: Cochetopa Natl. Forest, 1937, Snyder 135 (RM). Clear Creek Co.: Georgetown, 11 Aug 1871, Smith s.n. (NY, PHIL). Costello Co.: 2 mi N San Luis, 1 Sep 1942, Ginter 665 (CSU, RM). Delta Co.: Paonia, 23 Jul 1911, Osterhout 4596 (RM). Dolores Co.: ca King, 26 Aug 1935, Maguire et al. 12703 (CAS, GH, WS). Eagle Co.: 4 mi W Gypsum, 17 Aug 1942, Ginter 642 (CSU, RM). Garfield Co.: N side of Douglas Pass, 4 Aug 1978, Painter & Emrich 206 (CSU). Grand Co.: 6 mi NE Granby, 18 Aug 1937, Beetle 2304 (GH, LL, NDG, NY, RM). Gunnison Co.: Gunnison, 11 Sep 1917, Clokey 3013 (CAS, GH, NY, RM). Jackson Co.: W of Walden, 1 Aug 1917, Johnston 304 (RM). Larimer Co.: North Fork, 17 Aug 1903, Goodding 1922 (DS, F, NY, PHIL, RM). Mesa Co.: 20 mi SW Whitewater, 12 Aug 1937, Rollins 1922 (DS, LL, NDG, NY, RM, US). Moffat Co.: Dinosaur Natl. Monument, 19 Aug 1959, Barmore s.n. (WS). Montezuma Co.: Montezuma Natl. Forest, 2 Sep 1920, Copple 34717 (RM). Montrose Co.: Coventry, 2 Sep 1912, Walker 537 (GH, NY, RM, US). Ouray Co.: Ridgway, 20 Aug 1920, Payson 2311 (CAS, GH, NY, RM). Pitkin Co.: Highland Peak Quadrangle, Snowmass Creek, 23 Aug 1981, Feldman s.n. (NY). Rio Blanco Co.: Douglas Creek, 22 Sep 1979, Wilken 13563 (ASU, CSU). Routt Co.: Steamboat Springs, Aug 1892, Eastwood s.n. (CAS, MSU, OSU). Saguache Co.: Marshall Pass, 23 Aug 1896, Crandall s.n. (MO, RM). San Miguel Co.: Norwood Hill, 10 Aug 1912, Walker 434 (GH, NY, POM, RM). Summit Co.: Green Mountain Reservoir, 23 Jul 1972, Nelson 811 (CSU, NY, RM).

IDAHO: Adams Co.: 3 mi N Starkey, 24 Aug 1941, Christ 12945 (NY). Bannock Co.: 5 mi S Pocatello, 18 Aug 1949, Lingenfelter 747 (NY, RSA, UC, US, WS, WTU). Bear Lake Co.: Bloomington Lake, 5 Aug 1939, Davis 1619 (LL, NY, UTC). Bingham Co.: Taber, 12 Aug 1939, Davis 1730 (LL, UTC, WS). Blaine Co.: 4 mi N Ketchum, 24 Jul 1895, Henderson 3210 (DS, RM, WTU). Boise Co.: 10 mi S Lowman, Taylor 1811 (DAV). Bonneville Co.: 8 mi NW Swan Valley, 6 Aug 1952, Baker 9691 (NY, OSU, WTU). Butte Co.: Craters of Moon Natl. Monument, N Crater, 17 Jul 1953, Baker 10467 (NY). Camas Co.: Sawtooth Forest, Big Smokey Meadow, 11 Aug 1931, Hockaday 28 (RM). Canyon Co.: Dautrich Memorial Desert Preserve, 10 Jul 1978, Holsinger Kh780710-2 (NY). Cassia Co.: Mt. Harrison, 14 Jul 1939, Davis 1295 (NY, UTC). Clark Co.: 10 mi E Argora, 18 Aug 1939, Cronquist 1971 (NDG, NY, UTC). Custer Co.: ca 3/4 mi below Ocalpens Lake, 24 Aug 1980, Ertter 4022 (BYU, CAS, MONTU, NY, RM, UTC). Elmore Co.: ca 1/4 mi above Shake Creek Ranger Station, 8 Aug 1930, Pearse 16 (RM). Franklin Co.: W of Preston, 18 Sep 1932, Maguire 3827 (GH, MO, RM, UC, UTC). Fremont Co.: 1.5 mi S Last Chance, 25 Aug 1952, Baker 9935 (NY, OSU, WSU). Gooding Co.: Hagerman Valley, 21 Aug 1941, Davis 4291 (NY, WS). Jefferson Co.: Mud Lake, 24 Aug 1940, Christ 11816 (NY). La Plata Co.: 5 mi N Wendall, 30 Sep 1970, Hull s.n. (UTC) - approaches var. *sessiliflora*. Lemhi Co.: Salmon Forest, 18 mi E Big Creek, 27 Sep 1930, Bradley 58 (RM). Madison Co.: Range 43E, 7100 ft, 28 Jun 1979, Diffenback et al. 270 (UTC). Minidolca Co.: along Snake River, 28 Aug 1937, Christ & Ward 8848 (NY). Oneida Co.: Preston

- Whitney Hills, 24 Aug 1909, Smith 2033 (F, RM, UTC). Owyhee Co.: Silver City, 13 Jul 1910, Macbride 356 (DS, GH, NEB, NY, RM, US, WS). Teton Co.: Teton, 14 Jul 1934, Christ 5444 (NY). Twin Falls Co.: Shoshone Ranger Station, 14 Aug 1938, Gierisch 814 (UTC). Washington Co.: Spring Creek, 16 Aug 1941, Davis 4162 (UC, WS).

MONTANA: Beaverhead Co.: "Madison Co.", Monida, 4 Sep 1899, Nelson (DS, GH, NDG, NEB, NY, POM, RM, US, WTU). Big Horn Co.: 17.5 mi NW Hardin, 6 Jun 1956, Scharff s.n. (GH). Carter Co.: Box Elder Creek, 6 Aug 1934, Rose 385 (MONTU, WS). Cascade Co.: Great Falls, 27 Aug 1891, Williams 155 (NY, US). Custer Co.: U.S. Range Livestock Experiment Station, 14 Sep 1932, Kennedy K-64 (RM). Daniels Co.: 3 mi W Scobey, 18 Jul 1973, Stephens 67979 (NY). Dawson Co.: Colgate, near Glendive, 5 Sep 1892, Sandberg et al. 1004 (CS, DS, MO, NY, POM). Deer Lodge Co.: Anaconda, 12 Sep 1906, Blankinship 716 (F, MO, MONT, NEB, POM, RM, UC, US). Fallon Co.: 10 mi N Baker, 26 Jun 1968, Stephens 23324 (GH). Fergus Co.: Missouri River bottom, 31 May 1979, Ramsden & Lackschewitz 409 (MONTU). Gallatin Co.: Bozeman, 10 Aug 1941, Booth s.n. (MONT, WTU). Glacier Co.: Midvale, along railroad, 3 Sep 1901, Umbach 580 (NY). Granite Co.: 2 mi above Stony Creek, 9 Aug 1933, Hitchcock (CAS, DS, LL, MONT, POM, RM). Hill Co.: 1.3 mi E Box Elder, w/o date, Anderson et al. 5/2052 (WTU). Jefferson Co.: Benton Gulch Ranger Station, 30 Jul 1915, Cramer 108 (RM). Lewis and Clark Co.: Helena, 2 Sep 1889, Kelsey s.n. (DS, NY, POM). Liberty Co.: 12 mi NW Chester, 15 Jun 1952, Booth 52348 (WTU). Madison Co.: Ruby Range, 21 Aug 1982, Rosentreter 10291 (MONTU, NY). Missoula Co.: Bitterroot Mts, MacClay Mtn., 30 Sep 1976, Lackschewitz 7162 (MONTU, NY, WTU). Park Co.: 9 mi NW Wilsall, 28 Aug 1916, Suksdorf 145 (DS, GH, MO, MONTU, NY, OSU, RM, RSA, UTC, WS, WTU). Phillips Co.: S of Coulee, 12 Jan 1978, Lackschewitz 8137 (MONTU, NY). Powder Bay: Fort Howe, 31 Aug 1974, Bromenschenk 3 (MONTU). Powder Co.: 10 mi NE Helmsville, 1 Jul 1948, Hitchcock 17865 (RM, RSA, UC, WS, WTU). Richland Co.: SE of Poplar, 29 Sep 1979, Lackschewitz 9290 (MONTU). Ravalli Co.: 3 mi N Sula, 19 Aug 1945, Hitchcock & Muhlick 13732 (CAS, DS, GH, NY, POM, RM, UC, WS, WTU). Rosebud Co.: 2 mi S Birney, 27 Jul 1957, Bennett (DS, F, NY, UC). Sheridan Co.: Westby, 22 Jun 1927, Larsen 33 (GH, MO, PHIL, RM). Silver Bow Co.: Little Basin, 15 Aug 1936, Casich 298 (MONTU). Sweet Grass Co.: Greyclif, 27-30 Aug 1913, Eggleson 9901 (GH, US). Teton Co.: 9 mi S Choteau, 21 Aug 1931, Howell 7890 (CAS). Toole Co.: Shelby, 26 Jul 1981, Taylor 30875 (NY). Whetland Co.: 2 mi W Hedgesville, Aug 1934, Hitchcock 2430 (CAS, MONTU, RSA, WTU).

NEBRASKA: Webster Co.: Red Cloud, 3 Sep 1903, Bates 3069 (GH). Sioux Co.: sandy prairies, Aug-Sep 1927, Kramer 170 (NEB, numerous sheets and presumably representing several populations, some of these labeled 170a, the latter approaching var. nebraskana).

NEVADA: Churchill Co.: 1 mi W Carroll Summit, 31 Aug 1937, Goodner & Hemming 1313 (UTC). Clark Co.: Charleston Mts, Kyle Canyon, South slope, 2200 m, 15 Aug 1939, Clokey 8574 (LL, NY, UTC, WS); 8592 (GH, UTC, UC, WS) - Most collections from the upper slopes in the Charleston Mts. show some gene flow from the lower elevation var. leucanthemifolia. Douglas Co.: 2 mi E Tahoe Junction, 1 Aug 1939, Mason 12187 (ARIZ, UC, WS, WTU). Elko Co.: Ruby Mts., Cass House Park, 1 Aug 1981, Tiehm & Williams 6757 (CAS, NY, RSA, UTC). Esmeralda Co.: Middle Creek, White Mts., 12 Aug 1938, Jaeger s.n. (POM). Eureka Co.: 8 mi W Carlin, 24 Jun 1960, Passey et al. 8 (TEX, UTC). Humboldt Co.: Santa Rosa Range, Hinkey Summit, 20 Jul 1961, Constance 3732 (ARIZ, NY, TEX, UC, UTC). Lander Co.: E of Austin, 27 Aug 1981, Semple 5733 (NY). Lincoln Co.: Wilson Creek Range, Mt. Wilson, 13 Sep 1983, Tiehm 8386 (BYU, NEB, NY, RSA, TEX). Lyon Co.: 2 mi SE Toll, 4 Sep 1937, Stackhouse 28 (RSA, UC). Mineral Co.: Wassuk Range, 4 mi below Laphan Meadows, 22 Jun 1944, Train (NY, UC, UTC). Nye Co.: Toquima Range, Pine Creek Canyon, 4 Aug 1964, Holmgren & Reveal 1524 (BYU, NY, UTC, WTU). Ormsby Co.: Snow Valley, 8 Aug 1902, Baker 1438 (GH, MO, NY, UC, US). Storey Co.: Virginia Range, Mt. Davidson, 23 Jul 1979, Larson 14 (NY, UTC). Washoe Co.: Calneva, Stateline, 15 Sep 1938, Rose 38271 (CAS, F, GH, MO, MONTU, NY, UC, US, UTC, WS). White Pine Co.: Ruby Mts., 9800 ft, Sherman Mountain, 4 Aug 1939, Hitchcock & Martin 5674 (DS, POM, RSA, UC, UTC) - high elevational forms; southern Shell Creek Range, 7000 ft, 11 Aug 1969, Holmgren & Bethers 3884 (ARIZ, NY, RSA, UC, UTC, WTU) - low elevational forms.

NORTH DAKOTA: Billings Co.: Medora, 19 Sep 1935, Stevens s.n. (RM, UC). Burke Co.: 2 mi N Wildwood Park, 10 Jun 1969, Hegstad 3435 (NEB). McKenzie Co.: 10 mi N Grassy Butte, 3 Sep 1968, Stephens 28683 (ARIZ, NY). Oliver Co.: Fort Clark, Sep 1860, Hayden s.n. (MO). Slope Co.: Marmarth, 20 Aug 1915, Moyer 723 (NY, RM). Williams Co.: Williston, 28 Jul 1906, Bell 405 (NY).

OREGON: Baker Co.: Sumpter-Whitney Road, 3 Aug 1976, Strickler 650 (RM). Crook Co.: 5 mi W Prineville, 10 Aug 1962, Dean 405 (ASU, DAV, DS, NY, OSC, RSA, UC, UTC, WS, WTU). Grant Co.: 7 mi S Seneca, 30 Jul 1953, Cronquist 7675 (GH, NY, UC). Harney Co.: Burns, 27 Aug 1913, Lawrence s.n. (OSC). Lake Co.: Devil's Garden, NE of Fort Rock, 21 Jul 1977, Crosby 1681 (OSC). Malheur Co.: E side of Trout Creek Mts., 1.2 mi from Little Wildhouse Creek Rd., 2 Jul 1981, Ertter 4338 (NY). Wallowa Co.: Wallowa Mts., Hurricane Creek, 25 Aug 1898, Cusick 2099 (F, GH, MO, NDG, UC, US). Wheeler Co.: 19 mi N Mitchell, 5 Jul 1942, Peck 21573 (OSC).

SOUTH DAKOTA: Bennett Co.: La Creek P.O., 12 Aug 1911, Visher 2252 (F, NY). Corson Co.: 3 mi W Mobridge, 12 Sep 1968, Stephens 29151 (GH, NY). Harding Co.: 16 mi NE Buffalo, 1 Sep 1968, Stephens 28560 (DS). Perkins: S fork of Grand River,

headwaters, 20 Aug 1928, Lee s.n. (RM). Stanley Co.: White River, Over 6154 (US).

UTAH: Beaver Co.: 26 mi N Manderfield Exit, IH 15, 13 Aug 1983, Sundberg 2067 (TEX). Cache Co.: 20 mi SE Logan, 6300 ft, 10 Aug 1985, Tuhy 2453 (BYU). Carbon Co.: Price, 5600 ft, 10 Sep 1927, Flowers 801 (BYU, LL) - approaches var. aristata. Daggett Co.: 4 mi S Manila, 6500 ft, 20 Jun 1979, Welsh et al. 35 (BYU). Davis Co.: above Hot Springs N of Salt Lake City, 20 Sep 1913, Garrett 2737 (LL). Duchesne Co.: Uinta Mts., 6 mi ENE Hanna, 8550 ft, 19 Oct 1979, Goodrich 13721 (BYU). Emery Co.: San Rafael Swell, 3 mi from Summit, 7450 ft, Harris 627 (BYU). Garfield Co.: 22 mi N Escalante, 9000 ft, 18 Aug 1965, Holmgren et al. 2537 (BYU, NY, TEX); Henry Mts., Penellen Pass, 7800 ft, 11 Aug 1976, Neese 2441 (BYU) - intermediate to var. aristata. Grand Co.: Hill Creek, ca Weaver Reservoir, 8170 ft, 3 Aug 1965, Holmgren et al. 2373 (BYU, NY, TEX). Iron Co.: ca 10 mi N Brian Head, 7000 ft, 8 Aug 1983, Gieschen 91 (TEX). Juab Co.: upper Trout Creek Canyon, 8000 ft, 6 Sep 1978, Foster 7349 (BYU). Kane Co.: 8 mi E Kanab, 5120 ft, 12 May 1977, Foster 3765 (BYU). Millard Co.: W of Fillmore, 3 mi E Clear Lake, 13 Aug 1983, Sundberg 2065 (TEX). Morgan Co.: ca 4 mi NNE Lost Creek Reservoir, 6900 ft, 17 Sep 1983, Thorne 3128 (BYU). Piute Co.: ca 4 mi W Marysville, 25 Jul 1971, Atwood 3017 (BYU). Rich Co.: Walton Canyon, 8000 ft, 17 Jul 1981, Thorne 1412 (BYU). Salt Lake Co.: ca 2 mi E Wasatch Blvd., Mill Creek Rd., 26 Sep 1982, Neese 12445 (BYU). Sanpete Co.: skyline drive E Fairview, 10,000 ft, 2 Aug 1977, Clark 2982 (BYU). Sevier Co.: 4 mi SE Monroe, 7000 ft, 18 Sep 1978, Henroid 11 (BYU). Summit Co.: Park City, 7400 ft, 21 Jul 1978, Keil K12910 (TEX). Toole Co.: Oquirrh Mts., Sharp Mt., 8600 ft, 2 Aug 1970, Holmgren & Holmgren 4641 (NY, TEX). Uintah Co.: 8 mi W Vernal, 22 Sep 1978, Neese (BYU). Utah Co.: Timpanogus Cave Natl. Mon., 6 Aug 1983, Gieschen 80 (TEX). Wasatch Co.: W of Fruitland along highway 40, 10 Aug 1984, Sundberg & Lee 2593 (TEX). Washington Co.: Kolob, near reservoir, 3070 m, 5 Aug 1983, Higgins 14144 (BYU); summit of Beaverdam Mts., E slope 26 May 1978, Higgins 11913 (BYU) - this approaches var. leucanthemifolia; Beaver Dam Wash, 800 m, 31 May 1985, Higgins 15517 (BYU) - collections more or less intermediate to var. leucanthemifolia; Pine Valley Mts., 6600 ft, 27 Jul 1968, Gentry & Jensen 2185 (ASU, DS, NY, RM, RSA, TEX, UTC, WS) - these approach var. ambigua; Zion Natl. Park, 5250 ft, 25 Sep 1982, Welsh 21392 (BYU) - more or less intermediate to var. aristata. Wayne Co.: 8 mi SSW Fish Lake, 8500 ft, 11 Aug 1977, Higgins 10571 (BYU).

WYOMING: Albany Co.: Jelm, 11 Aug 1900, Nelson (MO, NEB, NY, POM, RM, US). Big Horn Co.: Red Bank, 22 Jul 1901, Goodding 337 (NY, RM, US). Campbell Co.: Gillette, 1 Sep 1926, Nelson (GH, MO, NY, RM, UC). Carbon Co.: Rawlins, 31 Aug 1900, Nelson 8179 (GH, NY, POM, RM, US). Converse Co.: Douglas, 4 Oct 1903, Nelson 9004 (GH, NY, RM, UC). Crook Co.: Devil's Tower, 21 Aug 1981, Marriott 937 (RM). Fremont Co.: 14 mi SE Lander, 20 Jun 1965, Scott 437

(RM, UC). Goshen Co.: 11.5 mi NNE Lingle, 27 Sep 1978, Nelson 2439 (RM). Hot Springs Co.: 15 mi E Thermopolis, 2 Sep 1922, Payson 3111 (RM). Johnson Co.: Buffalo, Oct 1900, Tweedy 3094 (NY, RM, TEX, WS). Lincoln Co.: Jackson's Hole, 3 Aug 1920, Payson 2187 (CAS, GH, MO, NY, RM). Natrona Co.: Powder River, 22 Jun 1939, Craig 3501 (POM). Park Co.: Clark's Fork of the Yellowstone River, 25 Aug 1948, Witt 1386 (NY, RSA, WS, WTU). Sheridan Co.: Dayton, Sep 1899, Tweedy 2035 (NY). Sublette Co.: 15 mi NE Bondurant, 15 Aug 1922, Payson 3053 (F, GH, NY, OSU, PHIL, POM, US). Sweetwater Co.: Creston, 29 Aug 1897, Nelson 4271 (MO, NY, RM, US). Teton Co.: near Jenny Lake, 17 Sep 1941, Nelson 4976 (DS, GH, RM). Uinta Co.: Evanston, 28 Aug 1900, Nelson 8112 (BYU, GH, NY, POM, RM, US, UTC). Washakie Co.: 4 mi E Worland 25 Jun 1970, Watson 466 (TEX). Weston Co.: Upton, 31 Aug 1909, Nelson 9293 (RM, UC). Yellowstone Natl. Park: Yellowstone Lake, 13 Aug 1897, Rydberg & Bessey 5109 (NEB, NY, PHIL).

5b. MACHAERANTHERA CANESCENS var INCANA (Lindl.) A. Gray

Diplopappus incanus Lindl., Bot. Reg., t. 1693, 1834. Dieteria incana (Lindl.) T. & G., Fl. N. Amer. 2: 100. 1842. Machaeranthra canescens var. incana (Lindl.) A. Gray, Bot. Wilkes Exp. Phan. 2: 340. 1874. Machaeranthra canescens var tephrodes A. Gray, Syn. Fl. 12: 206. 1886. (Based upon Diplopappus incanus Lindl.). Machaeranthra incana (Lindl.) Greene, Pittonia 3: 62. 1896. Machaeranthra tephrodes (A. Gray) Greene, Pittonia 4: 24. 1899. Aster tephrodes (A. Gray) Blake, Contr. U. S. Natl. Herb. 25: 555. 1925. TYPE: U.S.A. Oregon: "Columbia river", described from seeds grown in London. 1830. Douglas s.n. (holotype BM; fragment GH!; isotype, microfiche, DC-G!).

Machaeranthra attenuata Howell, Fl. N. W. Amer. 1: 314. 1900. Aster attenuatus (Howell) Peck, Man. Pl. Ore. 724. 1941. TYPE: U.S.A. OREGON: Wasco Co., "On the sandy plains and banks near the Dalles", w/o date, T. Howell s.n. (lectotype ORE; photolectotypes F!, GH!, US!).

A weakly differentiated taxon differing from the var. canescens primarily by its strict erect habit and more numerous larger heads.

DISTRIBUTION (Fig. 3): Sandy or alluvial soils along the lower Snake River and associated tributaries primarily in Washington and adjacent Oregon but a few plants (or genes therefrom) spilling over into the border regions of Canada, Idaho and northern California. Flowering: (Jun) Jul-Oct.

This variety is largely restricted to sandy soils along streams and grades into var. canescens upslope to the southeast and into var. shastensis to the southwest. A few collections from California possess the habit of var. incana but otherwise appear to be intermediate with var. shastensis. Machaeranthra inornata, placed in synonymy under the latter because of its eradiate heads, is such a collection.

REPRESENTATIVE SPECIMENS: CANADA. British Colombia: Lake Okanagan, 15 Sep 1890, McCoy 8 (GH, NY).

UNITED STATES. CALIFORNIA: Siskiyou Co.: Dry land, Weed, 11 Sep 1910, Butler 1869 (MO, RM, UC, US) - populations in this region grade into var. shastensis.

IDAHO: Kootenai Co.: near Spokane Bridge in Kootenai County, 20 Aug 1892, Sandberg 912 (F, NDG, PHIL).

OREGON: Baker Co.: Pine Creek, near the Snake River, 13 Jul 1901, Cusick 2439a (WS). Deschutes Co.: N of Redmond, ca 2900 ft, 6 Aug 1917, Standley 1080 (DS, OSC). Gilliam Co.: junction of John Day and Columbia Rivers, 14 Aug 1941, Brenckle & Shinnars s.n.

(RM). Hood River Co.: W of the Dalles, 8 mi W of Sherman Co. line, 5 Aug 1983, Sundberg 2029 (TEX). Jefferson Co.: Metolius, 17 Aug 1934, Jones 5733 (NY, WSU). Klamath Co.: dry slopes near old Fort Klamath, 13 Aug 1925, Thompson 308 (WTU). Morrow Co.: Boardman, 2 Sep 1941, Foerst s.n. (OSC). Sherman Co.: Grass Valley Canyon, 1 Oct 1938, Baker 1115 (RM). Umtilla Co.: near Ridge, 1000 ft, 6 Sep 1896, Brown (F, MO, NY, PHIL, RM, US). Union Co.: Sparta, 15 Oct 1897, Sheldon 9119 (GH, NY, RM, US). Wasco Co.: sandy soil, open pine woods, The Dalles, 15 Sep 1933, Jones 4238 (LL, UC, WTU).

WASHINGTON: Adams Co.: along road to Cunningham ca 2.5 mi N of junction with highway 26, 2 Aug 1983, Gieschen 76 (TEX). Asotin Co.: Anaconda Creek, 9 May 1926, St. John 4423 (WS) - an unusually shrubby form. Benton Co.: sand dune area, 12 Sep 1970, Langham 135 (WS, WTU). Chelan Co.: Lake Chelan, 16 Aug 1892, Lake & Hull s.n. (US, WS). Columbia Co.: Starbuck, 17 Sep 1893, Piper 1606 (F). Douglas Co.: near Wenatchee, 29 Sep 1945, Schallert 6981 (F). Ferry Co.: Keller Ferry, 10 Oct 1941, Gleason s.n. (WS). Franklin Co.: Connell, Jun 1903, Elmer s.n. (CAS). Garfield Co.: along Snake River, 4 mi W lower Granite Dam, 3 Aug 1983, Gieschen 77 (TEX). Grant Co.: Coulee City, 1 Sep 1892, Lake & Hull 691 (F, GH, MO, WS, WTU). Kittitas Co.: Ellensburg, 23 Aug 1898, Piper & Whited 854 (OSC, US, WS). Klickitat Co.: Columbus, 10 Jun 1886, Suksdorf 1560 (F, WS). Lincoln Co.: 5 mi E Odessa, 16 Aug 1919, Burrill s.n. (WS). Okanogan Co.: Loomiston, Aug 1897, Elmer 608 (NY, POM, US, WS). Spokane Co.: Spokane, 17 Aug 1892, Sandberg et al. 912 (CSU, DS, GH, MO, MONT, NY, POM). Stevens Co.: 7 mi N Hunter, 11 Aug 1949, Daubenmire 4942 (WS). Walla Walla Co.: Waitsburg, 11 Sep 1897, Horner 628 (GH, US, WS). Whitman Co.: Snake River Canyon, near La Folette Grade, 16 Oct 1920, St. John 3018 (LL, WS). Yakima Co.: Parker, 20 Sep 1935, Jones 8621 (MONT, WTU).

5c. MACHAERANTHERA CANESCENS var. SESSILIFLORA (Nutt.) B. L.
Turner

Phytologia 60:78. 1986.

Dieteria sessiliflora Nutt., Trans. Amer. Phil. Soc., Ser. 2, 7: 301. 1840. Machaeranthera sessiliflora (Nutt.) Greene, Pittonia 3: 60. 1896. TYPE: U.S.A. IDAHO?: "Denudated plains of the Rocky Mountains and Oregon", 1836. Nuttall s.n. (lectotype: BM; probable isoelectotypes, GH!). The specimen at GH is labeled "Rocky Mts. E. slope". If the latter is a Nuttall collection it could only have been collected in southern Idaho during Nuttall's trans-continental expedition of 1836. I suspect that there are labeling errors with the GH specimen and perhaps others; these are discussed in more detail below.

Machaeranthera magna A. Nels., Bot. Gaz. 53: 227. 1912. TYPE: U.S.A. IDAHO: Canyon Co., Falk's Store, sandy river flats, 2200 ft, 5 Sep 1910, J. F. Macbride 729. (holotype RM!; isotypes DS!, F!, GH!, NEB!, NY!, RM!, US!, WS!, WTU!).

Differing from the var. canescens in its stiffly erect habit, glandular-viscid vestiture throughout, more numerous, mostly appressed, involucre bracts, and more numerous heads which tend to be sessile.

DISTRIBUTION: Southern Idaho along the Snake River in sandy or gravelly flats mostly from 800-1200 m. Flowering: Aug-Oct.

Most workers have ignored this name or else applied it to habitually similar-appearing populations from Nebraska. I have designated the latter as var. nebraskana in the present treatment. The latter is readily distinguished from var. sessiliflora by its merely canescent vestiture; the latter stands morphologically and geographically closest to the var. glabra with which it intergrades.

The var. sessiliflora occurs largely in sandy soils along the Snake River of Idaho but in mountainous regions to the north, southeast and southwest of the Snake River from about Burley in Cassia Co. to near Weiser in Washington Co., it intergrades with the var. canescens.

REPRESENTATIVE SPECIMENS: UNITED STATES. IDAHO: Ada Co.: Boise, 6 Sep 1911, Clark 315 (DS, F, GH, NY, POM, RM, US, WS). Adams Co.: 7 mi N Council, 20 Aug 1966 (CAS, DAV, DS, F, MONTU, NY, OSU, RM, RSA, TEX, UC, US, UTC, WS, WTU) - approaches var. canescens. Blaine Co.: Corral, Camas Prairie, 5700 ft, 15 Aug 1916, Macbride & Payson 3834 (CAS, DS, GH, NY, POM, RM, US). Boise Co.: 3 mi below Banks, N Fork Payette River, 27 Aug 1951, Kruckeberg 2849 (OSU, RM, RSA, UC, WS, WTU). Camas Co.: 10 mi W Hill City, 9 Sep 1938, Christ 9796 (NY). Canyon Co.: Falks Store, 1 Sep 1911, (DS, F, GH, NY, POM, RM, US). Elmore Co.: 8.4 mi W Hill City, 13 Aug 1976, Dziekanowski et al. 2547 (MO, NY). Gem Co.: 2 mi S. Emmett, 11 Sep 1960, Munz 24285 (GH, RSA, UC). Idaho Co.: 1 mi NW Dixie, 27 Aug 1953, Baker 11173 (NY). Washington Co.: Nutmeg Mt., E Of Weiser, 28 Oct 1973, Ertter & Grimes 584/3 (NY).

5d. MACHAERANTHERA CANESCENS var. SHASTENSIS (A. Gray) B. L. Turner

Phytologia 60:79. 1986.

Machaeranthera shastensis A. Gray, Proc. Amer. Acad. Arts 6: 539. 1865. Aster shastensis (A. Gray) A. Gray, Bot. Calif. 1:

322. 1876. TYPE: U.S.A. CALIFORNIA: Siskiyou Co., Mt Shasta, 9000 ft, 1860-62, W. H. Brewer 1385 (holotype GH!; isotype US!).

Aster shastensis var. eradiatus A. Gray, Syn. Fl. 1²: 174. 1884. Machaeranthera eradiata (A. Gray) Howell, Fl. N. W. Amer. 1: 314. 1900. Machaeranthera shastensis var. eradiata (A. Gray) Cronq. & Keck, Brittonia 9: 238. 1957. TYPE: U.S.A. CALIFORNIA: Siskiyou Co., Scott Mountains, ca 9000 ft, 22 Aug 1876, E. L. Greene 1000 (holotype GH!; isotype NDG!).

Aster inornatus Greene, Erythea 3: 119. 1895. Machaeranthera inornata (Greene) Greene, Pittonia 3: 62. 1896. TYPE: U.S.A. CALIFORNIA: Siskiyou Co., Yreka, [31 Aug] 1876, E. L. Greene s.n. [1038] (holotype CAS!; isotypes NDG!, F!, GH!, NY!). Information given in brackets is from the GH sheet.

Machaeranthera inops Nelson & Macbride, Bot. Gaz. 62: 148. 1916. TYPE: U.S.A. OREGON: Klamath Co., Crater Lake Region, "on Glacier Peak", 21 Aug 1902, F. A. Walpole 2288 (holotype US!).

Machaeranthera inops var. atrata Nelson & Macbride, Bot. Gaz. 62: 148. 1916. TYPE: U.S.A. OREGON. Klamath Co., Crater Lake National Park, "on firm pumice gravel at the summit of Llao Rock", 14 Sep 1902, F. V. Coville 1470 (holotype US!).

A weakly defined variety differing from var. canescens in having, usually, sterile or neuter ray florets, often reduced ligules (or the ray florets absent) and often the bracts of the involucre in 3-5 series. It grades into the var. canescens to the northeast and west, especially in Bend and Crook counties, Oregon where rayed and non-rayed populations may occur in close proximity. Intergrades also occur on the eastern side of Lake Tahoe where both neuter and pistillate ray florets may occur in the same area or, indeed, population.

In Siskiyou Co. California (about Weed) and in adjacent Klamath Co., Oregon and northward to Deschutes and Jefferson Counties var. shastensis intergrades at lower elevations with the more robust, stiffly erect, many-headed var. incana.

DISTRIBUTION (Fig. 3): Inner Montane Regions of Northern California and adjacent Oregon from 1500-3400 m, just extending into Nevada in the Lake Tahoe region. Flowering: Aug-Oct.

REPRESENTATIVE SPECIMENS: UNITED STATES. CALIFORNIA: Eldorado Co.: Upper Truckee Valley, 6500 ft, 24 Aug 1972, Smith 3488 (UC) - intergrades with var. canescens are common in this county. Glen Co.: Black Butte, 10 Aug 1943, Howell 19255 (CAS, DS, LL). Lake Co.: Hull Mt., along Horse Ridge, 2075 m, 26 Jul 1977, Strother 1283 (NY, RSA, TEX, UC). Lassen Co.: Manzanita Creek, Volcanic Natl. Park, 6700 ft, 6 Sep 1945, Rose 45259 (CAS, NY). Modoc Co.: South Mt., Devil's Garden, 5200 ft, 27 Aug 1935,

Wheeler 3924 (GH, LL, POM). Nevada Co.: Lower end of Donner Lake, 8 Aug 1902, Heller 7128 (BYU, DS, GH, MO, NY, POM, RM, UC, US). Placier Co.: E side Lake Tahoe, Aug 1863, Brewer 2152 (MO, UC). Plumas Co.: Lake Almanor, near P.G.E. dam, 15 Sep 1950, Balls, 15859 (CAS). Siskiyou Co.: 1 mi E Etna, Scott Valley, 19 Sep 1949, Tracy 18564 (RSA, UC, WSU). Tehama Co.: on serpentine, Tedoc Gap, ca 4500 ft, 21 Jul 1949, Hoffman 2833 (CAS, UC). Trinity Co.: 6 1/2 mi N Carrville, 24 Aug 1936, Howell 12716 (CAS, TEX).

NEVADA. Washoe Co.: Calneva, 6400 ft, 15 Sep 1938, Rose 38271 (CAS, F, GH, MO, MONT, NY, UC, US, WS) - population with neuter ray florets; Steamboat Hot Springs, 4600 ft, 25 Sep 1982, Tiehm & Williams 7589 (MO, NY, RSA, UTC) - population without ray florets.

OREGON. Crook Co.: Prineville-Bend road, desert, 3 Sep 1902, Cusick 3008 (DS, F, GH, MO, NY, POM, UC, US, WTU). Deschutes Co.: Lapine, 27 Aug 1941, Rose 41424 (CAS) - populations in this county show considerable intergradation into var. canescens or vice versa. Douglas Co.: near Diamond Lake, 7 Aug 1897, Coville & Applegate 467 (DS, GH, US). Jackson Co.: Siskiyou Mountains, Ashland Peak, 2 Sep 1958, Dennis s.n. (OSC). Josephine Co.: Big Red Mt., Ashland Area, on serpentine, 22 Aug 1949, Whittaker s.n. (WS). Klamath Co.: 4 mi S Crescent, 11 Aug 1953, Cronquist 7768 (CAS, DS, GH, MONTU, RSA, UTC, WS). Lake Co.: 20 mi N Fort Rock, 17 Jul 1927, Peck 15715 (OSC). Marion Co.: Sand Mt., 18 Aug 1957, Bellinger 32499 (OSC).

5e. MACHAERANTHERA CANESCENS var. LEUCANTHEMIFOLIA (Greene) Welsh

Great Basin Naturalist 43: 316. 1983.

Machaeranthera leucanthemifolia (Greene) Greene, Pittonia 3: 64. 1896. Aster leucanthemifolius Greene, Erythea 3: 119. 1895. TYPE: U.S.A. NEVADA. Esmeralda Co., Candelaria, 6000 ft, Jun 1886, W. H. Shockley 268 (holotype CAS!; isotypes DS!, US!).

Machaeranthera hiemalis A. Nels, Amer. J. Bot. 21: 580. 1934. U.S.A. CALIFORNIA. San Diego Co.: 'near Jacumba', Devils Canyon, 14 Mar 1930, A. Nelson 11190 (holotype, RM!, Sheet II (with 2 separate plants), so designated by Nelson; isotypes DS!, PHIL!, RM!)

REPRESENTATIVE SPECIMENS. UNITED STATES: CALIFORNIA. Inyo Co.: Deep Springs Valley at College, 5220 ft, 10 Aug 1983, Morefield 1654a (NY). Mono Co.: Sherwin Hill, 5750 ft, 3 Sep 1942, Alexander & Kellogg 3435 (CAS, LL, MO, NY, UC, UTC) - robust forms approaching var. canescens. San Bernardino Co.: Clark Mountain, eastern part of County, 5000 ft, 15 Sep 1932, Munz 12858 (LL, MO, POM, UC).

NEVADA. Churchill Co.: Burnt Cabin Spring, 6400 ft, 18 Aug 1940, Beach 1028 (CAS, DS, UTC). Clark Co.: Kyle Canyon, 1300 m, 28 May 1937, Clokey 7740 (ARIZ, CAS, DS, F, LL, MO, NDG, NY, RM, RSA, UC, US, UTC). Esmeralda Co.: between Fish Lake Valley and Basalt, 3 Sep 1926, Ferris 6682 (DS, POM). Lincoln Co.: 0.4 mi N Hiko, 3850 ft, 6 Jun 1980, Harrison & Thorne 13260 (BYU, CSU, NY). Mineral Co.: near Basalt, 23 Jul 1976, Reveal 4585 (MO, NY, TEX). Nye Co.: White River Valley, 53 km (airline) S of Lund, 1570 m, 18 Jun 1978, Holmgren 8987 (BYU, CSU, MONTU, NY, RM, UT, UTC, WTU). Washoe Co.: Truckee Pass, 440 ft, 15 Sep 1909, Heller 9960 (DS, GH, NY, PHIL) - robust plants approaching var. canescens.

OREGON. Harney Co.: 3.5 mi S of junction with Mickey Hot Springs Rd on Alvord Well Rd, 12 Jul 1979, Price s.n. (OSC).

UTAH. Beaver Co.: road to Pot Sum Pa Springs, 7 mi S highway 21, 29 Aug 1980, Welsh et al. 214731 (NY). Millard Co.: SW Millard Co., wash N of Paddock No. 2, Desert Exptl. Range, 5400 ft, 7 Jul 1967, Alder 3 (MO, RM, UT). Washington Co.: Beaverdam Mountains, Castle Cliffs, 1150 m, 23 Aug 1984, Welsch & Welsh 23061 (BYU).

5f. MACHAERANTHERA CANESCENS var. ZIEGLERI (Munz) B. L. Turner

Phytologia 60:79. 1986.

Machaeranthera canescens subsp. zieglerei Munz, Aliso 7: 65. 1969. TYPE: U.S.A. CALIFORNIA, Riverside Co., N side Santa Rosa Mt, 6500-7500 ft, 30 Sep 1968, Louis B. Ziegler s.n. (holotype RSA; isotype CAS!).

An isolated series of populations differing from typical var. canescens in having a much larger involucre and better-developed perennial roots.

DISTRIBUTION (Fig. 3): UNITED STATES. California: known only from Riverside Co. in the Santa Rosa Mountains where it occurs in dry conifer forests from 1400-2000 meters. Flowering: Jul-Oct.

This variety grades northward into the var. canescens (populations of which, along the eastern Sierra Nevada, also possess exceptionally large heads, presumably as a result of past introgression with the var. leucanthemifolia, to judge from the glandular vestiture intermixed with the canescent condition which often occurs in the plants of this region).

REPRESENTATIVE SPECIMENS: UNITED STATES. CALIFORNIA: Riverside Co.: dry ridge near Santa Rosa Peak, 7600 ft, 13 Aug 1938, Munz (CAS, POM, UC, UTC, WSU); summit of Santa Rosa Mountain, 8100 ft, 25 Jul 1949, Jaeger s.n. (RSA).

5g. MACHAERANTHERA CANESCENS var. AMBIGUA B. Turner

Phytologia 60:77. 1986. TYPE: UNITED STATES. ARIZONA: Coconino Co.: Flagstaff, 28 Aug 1922, H. Hanson A7 (holotype, TEX!, isotypes ARIZ!, F!, MO!, NEB!, NY!, OSU!, PHIL!, RM!, TEX!).

Machaeranthera oxylepis Greene, Pittonia 4: 25. 1899. TYPE: U.S.A. ARIZONA: Cochise Co., Apache Pass, Sep 1881, J. G. Lemmon s.n. (holotype NDG!). The holotype is perhaps a collection with a label error; several additional collections by Lemmon from Cochise Co., Sep 1881, were examined, but all were typical M. asteroides (except for an Aster sp., yet further suggesting a mixing of material under this label).

Machaeranthera scoparia Greene, Leaflet. Bot. Observ. Crit. 2: 227. 1912. TYPE: U.S.A. ARIZONA: Coconino Co., NW of Turkey Tanks, 26 Aug 1911, Jardine & Hill s.n. (lectotype US!; isolectotype RM!). Specimens were not found in NDG; the US specimen has written on this, "Type specimen"; I take this to be the hand of E. L. Greene. The specimen at RM has a Forest Service number, 32679, stamped upon the label.

Machaeranthera angustifolia Woot. & Standl., Contr. U.S. Natl. Herb. 16: 188. 1913. Not M. angustifolia Rydb. (1910). TYPE: U.S.A. NEW MEXICO: Guadalupe Co., Fort Smith to the Rio Grande, "probably in the Sandia Mountains", 1853, J. M. Bigelow s.n. (holotype US!; probable isotype NY!). The NY label has written it, "Hurrah Creek. Sept 25th" which Standley (1915) notes to be a stream in the northern part of Guadalupe Co.

Differing from var. canescens in its larger heads and appressed, merely pubescent involucre bracts and usually glabrous achenes (or nearly so).

DISTRIBUTION (Fig. 3): Mostly northcentral Arizona from 5000-8500 ft in pine forests, extending into northern New Mexico and adjacent Colorado where it grades into the var. canescens and possibly M. bigelovii. Flowering: Aug-Oct.

I have not chosen to adopt any of the specific names listed in the above synonymy since, to some extent, each poses a problem in typification.

In Utah there exists a series of populations on the Aquarius Plateau in Garfield Co. which I have called var. canescens which appear to be intermediate with var. ambigua, at least as to involucre characters, possessing larger involucre bracts with mostly appressed, merely pubescent bracts (e.g., Rydberg & Carlton 7392, 7441, GH, NY; M. E. Jones 6001, US; Hreha 376, UTAH; etc.). These characters intergrade extensively with those of the var. canescens in this region and I have not seen any populations (or individuals) which I could unequivocally assign to the var. ambigua. In

Washington Co. Utah populations of the var. canescens in the Pine Valley Mountain also approach the var. ambigua (e.g. Gould 1383, ARIZ, CAS, GH, NDG, NY, UC).

Populations of var. ambigua in New Mexico are generally taller and have involucre which approach those of M. asteroides var. asteroides, i.e. involucral bracts with more subulate, reflexed apices. The type of M. angustifolia Woot. & Standl. applies to such plants.

REPRESENTATIVE SPECIMENS. UNITED STATES. ARIZONA: Apache Co.: 15 mi W Window Rock, 1 Sep 1962, Turner 4910 (TEX). Coconino Co.: 10 mi W Flagstaff, 14 Aug 1946, Parker et al. 6158 (ARIZ, DS, LL, US, UTC). Mohave Co.: Slopes about Pine Lake, near Hualapai Peak, 6 Sep 1969, Correll 37809 (LL). Navajo: just W of Heber on Payson road, 28 Aug 1973, Sexton s.n. (ASU). Yavapai Co.: Ash Fork, 5000 ft, 14 Jul 1983, Gieschen 84 (TEX).

COLORADO: Archuleta Co.: NW of Pagosa Springs, 7100 ft, 8 Sep 1924, Payson 1418 (RM). Huerfano Co.: La Veta, 7000 ft, 21 Aug 1897, Crandall 3216 (NY). La Plata Co.: 30 mi E Durango, 12 Oct 1952, Twisselmann 1576 (CAS) - cultivated from seed.

NEW MEXICO: Bernalillo Co.: highway 44, 0.3 mi below Sandia Peak Winter Sports Area, 8500 ft, 22 Aug 1983, Gieschen 115 (TEX). Catron Co.: 7 mi W Datil, 7450 ft, 3 Sep 1956, Barneby 12899 (CAS, NY). Los Alamos Co.: Water Canyon, 5 Jul 1978, Fox & Tierney 3 (NMC). Mora Co.: Watrous, 1950 m, 27 Aug 1926, Arsene & Benedict 17404 (F, US). Rio Arriba Co.: near Dulce, 20 Aug 1911, Standley 8150 (US). Santa Fe Co.: W slope, Sangre de Cristo Mts., 7200 ft, 14 Aug 1963, Bennett s.n. (TEX). San Juan Co.: Crystal, 8 Jul 1972, Francke & Cazier s.n. (ASU). Taos Co.: 16 air miles NE Taos, 7400 ft, 19 Aug 1973 (ASU, BYU, DS, MONTU, NMC, NY, RSA, UT, UTC, WTU) - grades toward var. glabra. Valencia Co.: Zuni Mts., Zuni Canyon Road, 7440 ft, 7 Sep 1968, Riffle 853 (NMC).

5h. MACHAERANTHERA CANESCENS var GLABRA A. Gray

Machaeranthera canescens var. glabra A. Gray, Pl. Wright 1. 89. 1850. Machaeranthera canescens var. viridis A. Gray, Syn. Fl. 1²: 206. 1884. TYPE. UNITED STATES. NEW MEXICO: Dona Ana Co., Rio Grande Valley at Presidio San Elizario on sand-bars, 22 Sep 1849, C. Wright 262 (field no. 1258). (lectotype, selected here, GH!; isolectotypes GH!, MO!, UC!). Gray cited at least two separate collection sites; in addition he combined 2 or more of Wright's field numbers. I have selected that sheet with Wright's field number 1258 on the label, the locality corresponding to the collection site as given by Shinnars (1940). This is also the type for var. viridis: Gray apparently renamed his original variety, annotating the sheet accordingly.

Machaeranthera linearis Greene, Bull. Torrey Bot. Cl. 24: 511. 1897. Aster linearis (Greene) Cory, Rhodora 38: 407. 1936. TYPE: U.S.A. NEW MEXICO. Dona Ana Co., Mesilla Valley, 3900 ft, 6 Sep 1897. E. O. Wooton 444 (lectotype NDG!; isolectotypes DS!, GH!, MO!, NMC!, NY!, POM!, RM!, UC!, US!).

Machaeranthera fremontii Rydb., Bull. Torrey Bot. Cl. 32: 123. 1905. TYPE: U.S.A. COLORADO: "Black Soil of river bottoms (Platte waters) among tall plants", according to Fremont's notes, 20 Jul 1844, Fremont 421 (holotype NY!).

Differing from the var. canescens in its stiffly erect habit, more numerous heads and usually more numerous ray florets, in addition the leaves tend to be glabrous above and below.

DISTRIBUTION: Mostly sandy soils from 1000 to 1800 m along the eastern edge of the Rocky Mountains from southern Wyoming to New Mexico and adjacent states; extending into northcentral Chihuahua, Mexico. Flowering Jul-Sep.

It grades along the Rocky Mountains into the var. canescens and possibly into M. bigelovii; in northwestern New Mexico it grades into the var. aristata. In northeastern Colorado it grades into the var. nebraskana, the latter being larger-headed with more reflexed involucre bracts.

REPRESENTATIVE SPECIMENS: MEXICO. Chihuahua: Chihuahua, sand dunes, 10-19 Oct 1935, Le Sueur 330 (CAS, UC, TEX).

UNITED STATES. ARIZONA: Apache Co.: on the mesa leading S out of Chinle toward highway 264, 8 Aug 1971, Halse 599 (ASU, LL, OSU, UNLV).

COLORADO: Adams Co.: Brighton, 14 Sep 1908, Johnston 399A (NY). Arapahoe Co.: 0.2 mi SE of Junction of highways 83 and 70, 5550 ft, 18 Sep 1961, Brunquist B-173 (CSU). Archuleta Co.: ca 8 mi W Piedra, 22 Aug 1970, Watson 527 (MONTU, TEX). Boulder Co.: Valley near Boulder, 20 Aug 1906, Robbins 2580 (RM). Costilla Co.: sandy soil, Mumms farm, 3 mi SW of Fort Garland, 28 Aug 1956, Klinger s.n. (CSU). Denver Co.: prairies, Denver, 5300 ft, 5 Sep 1917, Clokey 2951 (CAS, F, GH, NY, RM, TEX, UC, US). El Paso Co.: Coral Bluffs, 17 mi E Colorado Springs, 17 Aug 1924, Bacigalupi 890 (DS, GH). Fremont Co.: w/o locality, 1872, Brandeggee B523 (NY, UC). Jefferson Co.: Bear Creek area, E of Morrison, 5000 ft, 30 Aug 1972, Mooradian 72-467 (CSU). Larimer Co.: Ft. Collins, 5000 ft, 29 Sep 1894, Baker s.n. (MO, NY). Washington Co.: 3 mi S Otis, 26 Sep 1972, Stephens 62543 (NY). Weld Co.: 2.7 mi N Roggen, 29 Sep 1982, Wilken 13920 (BYU, CSU, NY, RM).

KANSAS: Hamilton Co.: 1 1/2 mi S Syracuse, 24 Sep 1970, Stephens 45721 (NY). Morton Co.: 5 mi N Elkhart, 1 Oct 1972, Stephens 62914 (NY).

NEW MEXICO: Bernalillo Co.: Albuquerque, sandy soils, 5129 ft, 6 Jul 1983, Gieschen 29, 30 (TEX). Colfax Co.: Chico rico Canyon, near Raton, 25 Aug 1900, Cockerall s.n. (NY). Dona Ana Co.: Mesilla Valley, 20 Sep 1907, Wooton & Standley 3200 (ARIZ, DS, F, MONT, OSU, RM, UC, US). Eddy Co.: Carlsbad, 10 Sep 1932, Whitehouse s.n. (TEX). Los Alamos Co.: Jemez Mts., Junction of Potrillo and Water Canyons, 6400 ft, 3 Sep 1974, Levin 417 (DAV). Luna Co.: 20 mi W Las Cruces, 30 Sep 1944, Barkley 14NM722 (TEX). McKinley Co.: 7 mi W Crownpoint, 8 Sep 1977, Spellenberg 4828 (NMC, NY). Otero Co.: 35 km N El Paso Tex along highway 54, 2 Oct 1978, Garcia 744 (CAS, DAV, TEX). Quay Co.: 2 mi N San Juan, 17 Sep 1952, Castetter 9392 (NMU). Rio Arriba Co.: ditch banks, Lybrooks, 29 Aug 1932, Nelson 283 (RM). Roosevelt Co.: sandy soil in oak shinnery, 4 mi SW Kenna, 25 Sep 1946, Whitehouse 17179 (NY, UC). Sandoval Co.: 18 mi N Albuquerque, 29 Aug 1974, Schultz 1313 (ARIZ, BYU, DAV, GH, NY, UT, UTC, WSU). San Juan Co.: floodplain of Chaco Wash, Chaco Canyon Natl. Monument, 31 Aug 1980, Betancourt s.n. (ARIZ) - most of the collections from this county tend to intergrade into var. aristata. Socorro Co.: Rio Grande basin, E of San Antonio, 17 Sep 1948, Dunn 4884 (NMU). Torrance Co.: Laguna del Perro, E of Willard, 6 Sep 1965, Barneby 13832 (CAS, NY). Union Co.: 2 mi SE Grenville, 26 Sep 1969, Correll 38015 (GH, LL, UC). Valencia Co.: 15.2 mi NW Pie Town, 8 Sep 1974, Schultz 1529 (NY, WTU).

TEXAS: El Paso Co.: Franklin Mountains, 30 Oct 1962, Correll 26529 (LL, UC). Hockley Co.: in open woods, 5 Sep 1927, Harris 94 (F, US). Hudspeth Co.: W of Sierra Blanca, 1 Oct 1946, Barkley 14T756 (F, MO, RM, RSA, TEX). Randall Co.: Lubbock, Sep 1929, Reed 3251 (US). Winkler Co.: 10 mi NE Kermit, 17 Oct 1970, Watson 571 (TEX).

WYOMING: Albany Co.: Laramie Hills, 21 Aug 1900, Nelson 8226 (GH, NEB, NY, POM, RM, US); Granite Canyon, 10 Sep 1932, Nelson 345 (RM, UC, WTU). Platte Co.: Hartville Junction, Sep 1904, Nelson 8966 (NY, RM). Laramie Co.: near Hillsdale, 28 Aug 1926, Heller 14316 (DS, F).

5i. MACHAERANTHERA CANESCENS var. NEBRASKANA B. L. Turner

Phytologia 60:78. 1986. TYPE: UNITED STATES. NEBRASKA: Sheridan Co.: 2 mi E Ellsworth, Sandhill prairie pasture on dry, loose sand, 27 Aug 1968, Steve Stephens 28307 (holotype, NY!; isotypes ARIZ!, DS!, GH!).

Differing from var. canescens in being taller and more stiffly erect with larger, 8-9 seriate, involucre (0.9-1.5 cm high) with generally more numerous ray florets (34-54).

DISTRIBUTION (Fig. 3): Sand hills of western Nebraska and perhaps just extending into the peripheral states. Flowering: Aug-Sep.

A very well-marked variety which Rydberg (1932) recognized, in part, as M. sessiliflora. The type of the latter, however, possesses a well-marked, cauline glandularity and was presumably collected by Nuttall in Idaho. This is treated as a variety of M. canescens in the present treatment (cf. below). The var. nebraskana intergrades westward and northward into the var. canescens; southward it grades into var. glabra.

The var. nebraskana, while widespread over the dune regions of western Nebraska, is nonetheless relatively rare at any give site. For example, I encountered the species along the highway between Gordon and Elliston Nebraska at only 3 sites (ca 14.6 mi, 23 mi, and 37 mi S of Gordon). At each of these the populations comprised 20-80 plants always on bare white sand on the back-side of relatively high dunes.

REPRESENTATIVE SPECIMENS: UNITED STATES. NEBRASKA: Box Butte Co.: Alliance, "arrow hill", 22 Aug 1909, Churchill s.n. (NEB). Cheyenne Co.: "prairies", Aug 1889, Smith s.n. (PHIL). Cherry Co.: 16 mi W Merriman, 23 Aug 1967, Stephens 17047 (DS, GH, NY, UC); sandhills between Duck and Rice Lakes, 22 Aug 1973, Churchill 2478 (MO, NEB). Dawes Co.: Chadron, 5 Sep 1899, Bates s.n. (NEB, NY); Chadron Creek Canyon, 6 Sep 1940, Toldstead (NEB). Garden Co.: w/o locality, 15 Jul 1911, Churchill s.n. (NEB). Hooker Co.: Middle Loop River near Mullen, Sep 1893, Rydberg 1721 (US). Logan Co.: 15 mi N Stapleton, 11 Sep 1970, Johnson 2883 (NY). Scotts Bluff: Wild Cat Range at Game Preserve, deep canyon, 28 Aug 1941, Tolstead 411483 (NEB, RM). Sheridan Co.: 13 mi N of Hay Springs, 10 Sep 1964, Nixon 240 (RM). Thomas Co.: near Plummer Ford, Dismal River, 23 Aug 1893, Rydberg 1734 (GH, NY).

SOUTH DAKOTA: Pennington Co.?: "Bad Lands", 1906, Skinner 317 (RM).

5j. MACHAERANTHERA CANESCENS var. ARISTATA (Eastwood) B. Turner

Phytologia 60:78. 1986. Aster canescens Pursh var. aristatus Eastwood, Proc. Calif. Acad. Sci., Ser. 2, 6: 296. 1896. TYPE: U.S.A. UTAH: San Juan Co., Willow Creek, 14 Jul 1895, A. Eastwood 45 (holotype CAS!).

Machaeranthera rigida Greene, Pittonia 4: 25. 1899. TYPE: U.S.A. ARIZONA: Navajo Co., "Kearn's [Keams] Canon", 20 Aug 1897, Zuck 41 (holotype NDG!).

Machaeranthera cichoriacea Greene, Leaflet Bot. Observ. Crit. 1: 148. 1905. Aster cichoriacea (Greene) Blake, Contr. U.S. Natl.

Herb. 25: 555. 1925. TYPE: U.S.A. COLORADO: Mesa Co., Bottom of canyon at Deer Run, 4700 ft, 25 Aug 1901, C. F. Baker 918 (holotype NDG!; isotypes MO!, NY!, POM!, US!).

Machaeranthera pulverulenta var vacans A. Nels., Bot. Gaz. 56: 70. 1913. M. canescens var. vacans (A. Nels.) Welsh, Great Basin Naturalist 43: 316. 1983. TYPE: U.S.A. UTAH. San Juan Co., Geyser Basin, "dry sandy park", 30 Jul 1912, E. P. Walker 360 (lectotype, selected here, RM!; isolectotypes GH!, NY!).

Differing from var. canescens in being more stiffly erect, taller, with more numerous florets and especially by the glandular-pubescent stems which are otherwise glabrous, or nearly so.

DISTRIBUTION (Fig. 3): Mostly sandy areas of Southeastern Utah and adjacent status (Colorado, New Mexico and Arizona) from 1000-2000 m in Juniperus-Artemisia associations. Flowering Aug-Sep.

The var. aristata intergrades westward and upslope, especially in Garfield and Wayne counties Utah, with the var. canescens. Plants seemingly intermediate between these variants include, among others, Cottam 6490, 9155 (UTAH) and Howell & True 44855 (CAS).

Collections from easternmost Colorado and adjacent Utah, including the types of M. cichoriacea and M. pulverulenta var. vacans, approach the var. canescens. Over most of its range the var. aristata is markedly glandular with little puberulence. Collections upslope (i.e. above 1800 m or so) on all sides of var. aristata tend to become minutely puberulent or canescent and less glandular (i.e., approach var. canescens). No doubt there has been periodic introgression between the two varieties. In northwestern New Mexico and adjacent Arizona var. aristata grades into var. glabra. The latter also occurs in sandy soils at about the same elevations as does var. aristata.

REPRESENTATIVE SPECIMENS: UNITED STATES. ARIZONA: Apache Co.: Canyon de Chelly National Monument, moist areas in canyon, 17 Sep 1955, Demaree 38419 (RSA). Coconino Co.: between Oraibi and Hotevilla, 5 Sep 1952, Deam 4122 (ARIZ, CAS). Mohave Co.: Arizona Strip District, Cottonwood Spring, 10 Sep 1980, Bundy 215 (ARIZ, BYU). Navajo Co.: Monument Valley, 14 Sep 1938, Eastwood & Howell 6647 (CAS, GH).

COLORADO. Mesa Co.: Badger Wash Experimental Area, 5000 ft, 26 Jul 1973, Reid & Ranck s.n. (RM); Colorado National Monument, 6000 ft, 11 Sep 1968, Porter & Porter 10595 (RM). La Plata Co.: Hesperus, 1963, Jefferies 6 (CSU). Montezuma Co.: head of Spruce Canyon, Mesa Verde Natl. Park, 17 Sep 1947, Weber 3619 (CAS, CSU, RSA, TEX) - approaches var. canescens.

NEW MEXICO: San Juan Co.: ca 5 air mi SW Fruitland, 8 Sep 1983, Spellenberg 7577 (NMC, NY).

UTAH: Carbon Co.: 5 mi E Wellington, 5 Sep 1962, Welsh & Moore 1834 (BYU). Emery Co.: adjacent to Carbon-Emery Co. line, along Utah highway 10, S of Price, 3 Oct 1969, Welsh et al. 9474 (BYU, NY, UTC). Garfield Co.: 7 mi E on Poison Springs Road, 23 Aug 1977, Neese & White 4036 (BYU). Grand Co.: Colorado River, W of Moab, 3900 ft, 4 Sep 1968, Howell & True 44740 (CAS, NY). Kane Co.: ca 11 mi NNE of Kanab, 5 Oct 1982, Welsh 21437 (BYU, NY, RM). San Juan Co.: S of Needle Rock, Monument Valley, 8 Sep 1944, Holmgren 3800 (GH, NY, UC, UTC, WTU). Uintah Co.: 13 mi SE Vernal, 13 Sep 1982, Goodrich & Atwood 17979 (NY). Washington Co.: Pine Creek Canyon, 4800 ft, Zion National Park, 13 Sep 1968, Howell & True 45291 (CAS). Wayne Co.: Henry Mountains, Notom Road crossing of Pleasant Creek, 5000 ft, 17 Sep 1976, Neese 2606 (BYU).

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